

**Norfolk CSO Sediment Remediation Project  
Five-Year Monitoring Program**

**Annual Monitoring Report - Year Two, April 2001**



**Elliott Bay/Duwamish Restoration Program**

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Prepared for the  
Elliott Bay/Duwamish Restoration Program Panel  
by the  
King County Department of Natural Resources

Panel Publication 31

November 2001

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by  
Scott Mickelson  
King County Department of Natural Resources

Panel Publication 31

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**November 2001**

Individuals and organizations needing further information about the Elliott Bay/Duwamish Restoration Program should contact the Administrative Director at the following address and telephone number:

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The Panel of Managers holds regularly scheduled meetings that are open to the public. Technical Working Group and committee meetings are scheduled on an as-needed basis, and are also open to the public. Meetings are generally held at the National Oceanic and Atmospheric Administration, National Marine Fisheries Service - Regional Directorate Conference Room, Building 1, 7600 Sand Point Way NE, Seattle. The Panel recommends that you contact the Administrative Director at the above phone number to confirm meeting schedules and locations. The panel also holds periodic special evening and weekend public information meetings and workshops.

#### General Schedule for Panel and Committee Meeting Dates

Panel: quarterly, first Thursday of January, April, July, October, 9:30 A.M. - 12:30 P.M.  
Habitat Development Technical Working Group: third Thursday of every month, 9:30 A.M. - 12:30 P.M.  
Sediment Remediation technical Working Group: scheduled as needed.  
Public Participation Committee: scheduled as needed.  
Budget Committee: scheduled as needed.

#### Environmental Review of Specific Projects

Formal hearings and comment periods on appropriate environmental documents for proposed sediment remediation and habitat development projects will be observed. Please contact the Administrative Director for more information.

<p>This information is available in accessible formats on request at (206) 296-0600 (voice) and 1-800-833-6388 (TTY/TDD users only).</p>
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# 1 INTRODUCTION

This report presents the results of the fourth sampling event of a five-year monitoring program at the Norfolk combined sewer overflow (CSO) sediment remediation site. The purpose of the five-year program is to monitor sediment placed as backfill material at the site for potential recontamination from CSO and other discharges. The fourth monitoring event occurred in April 2001, two years after completion of remedial activities. This monitoring event was intended to collect data on the chemical characteristics of the backfill material after the second year and compare those data to baseline chemical conditions. Included in this report are a project background, descriptions of sampling and analytical methodologies, analytical results, and a quality assurance review of the analytical data.

## 1.1 Project Background

Sediment remediation at the Norfolk CSO site was undertaken to partially fulfill sediment remediation requirements of a 1991 Consent Decree, which defined the terms of a natural resources damage agreement between King County (along with the City of Seattle) and federal, state, and tribal natural resources trustees. The Norfolk CSO site was chosen by the Elliott Bay/Duwamish Restoration Program (EBDRP) Panel as one of four sites prioritized for potential sediment remediation.

A site characterization and cleanup study was performed in 1994 and 1995, and the cleanup study report was issued in 1996 (EBDRP, 1996). Chemicals of concern at the site included mercury, 1,4-dichlorobenzene, bis(2-ethylhexyl) phthalate and polychlorinated biphenyls (PCBs), all present at concentrations exceeding State of Washington Sediment Management Standards (SMS) sediment chemical criteria values that define the cleanup screening levels. PCB "hot spot" concentrations at the site also exceeded Toxic Substances Control Act (TSCA) limits for hazardous waste disposal.

Site remediation began in early February 1999 and was completed by late March 1999. Remedial activities consisted of dredging and disposal of contaminated sediment and backfilling the dredged area to original grade with clean sediment from the Duwamish River Turning Basin. Contaminated sediments were removed from the site by mechanical dredge and dewatered on shore in a containment area first arranged to segregate batches about 50 cubic yards (cy) in size and later reconfigured to handle larger batches.

Sediment samples were collected daily from each 50-cy batch and analyzed for PCB concentrations to determine the appropriate disposal destination. Sediments with a PCB concentration greater than 45 parts per million (ppm) were transported to a Subtitle C landfill in Arlington, Oregon for disposal. Sediments with a PCB concentration less than 45 ppm were transported to a Subtitle D landfill in Bremerton, Washington for disposal. A total of 5,190 cy of sediment was removed during the remediation, of which approximately 1,900 cy were transported to the Subtitle C landfill as hazardous waste. Sediment was generally removed to a depth of three feet, however, remediation in the PCB hot spot areas required removal of sediment up to a depth of nine feet. Confirmation testing subsequent to dredging activities indicated that, in some of the deepest-dredged areas, sediments were left

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in place that contained PCB concentrations greater than SMS chemical criteria. Discussions with project oversight personnel from the EBD RP Panel and State of Washington Department of Ecology (Ecology) determined that, at a depth of nine feet below original grade, these PCB-contaminated sediments could be left in place.

Clean backfill sediment was obtained from the Duwamish River Turning Basin during normal, maintenance dredging operations by the Army Corps of Engineers (ACOE). Data collected by the Corps prior to maintenance dredging indicated that this material was suitable for use as backfill material (ACOE unpublished data, 1998). A sample was also collected from the Turning Basin sediment after it was placed on a barge and just prior to backfilling activities. Analytical results from this sample confirmed the suitability of the sediment as backfill material (King County unpublished data, 1999). No organic chemicals were detected in the sample and metals were detected at levels indicative of natural, area-wide crustal sediment concentrations. Approximately 6,700 cy of Turning Basin sediment was used to backfill the dredged area at the Norfolk CSO sediment remediation site. A site closure report was issued in August 1999 (EBDRP, 1999).

The site hydraulic permit, issued by the Washington State Department of Fish and Wildlife prior to remediation, requires that the site be monitored for a period of five years following remedial activities to evaluate possible recontamination of the backfill sediment as a result of continuing CSO or storm water discharges. To comply with this permit, a five-year monitoring plan was prepared which includes sampling and analysis of surficial sediments from four stations in the backfilled area. Analytical data will allow King County to evaluate the chemical characteristics of the sediment and assess possible recontamination over time. Monitoring activities will be performed in accordance with a sampling and analysis plan addendum prepared by King County (King County, 1999).

## **1.2 Site Description**

The Norfolk CSO sediment remediation site is located in the Duwamish River, above the Turning Basin at approximately river kilometer (km) 10 in the City of Tukwila (Figure 1). The site is located upstream of the river reach maintained for commercial navigation and, as such, has maintained its natural channel as well as some riparian habitat (EBDRP, 1996). The shoreline is characterized by a steeply sloping, erosional bank maintained with large concrete riprap. The bank joins a gently sloping, intertidal mud shoreline that is completely exposed during extreme low tides.

The Norfolk CSO outfall originates at King County's Norfolk Street Regulator Station near South 102<sup>nd</sup> Street and East Marginal Way in Tukwila (EBDRP, 1996). The outfall structure has a flap gate over the 84-inch discharge pipe and a concrete splash plate that is exposed during normal low tides. The remediation site is located adjacent to the outfall structure and is characterized by exposed, intertidal mud habitat as well as subtidal riverbed. The intertidal zone has been channelized, both by the discharge of the Norfolk CSO and by a storm drain outfall that drains a Boeing Company parking lot adjacent to the CSO outfall.

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## 2 SAMPLE COLLECTION

This section describes sampling activities conducted in April 2001. All sampling activities were conducted following guidance suggested in the Puget Sound Protocols (PSEP, 1996a and 1998).

### 2.1 Sample Locations and Station Positioning

Sampling locations were selected and coordinates determined prior to field activities. Final sampling locations were selected prior to the October 1999 six-month monitoring event (King County, 2000) and were designed to assess potential recontamination at the site and evaluate the chemical characteristics of the backfill material at the following locations:

- within the Norfolk CSO channel, prior to its confluence with the Boeing storm drain channel (NFK501);
- on the delta after the confluence of the Norfolk CSO and Boeing storm drain channels (NFK502);
- within the Boeing storm drain channel prior to its confluence with the Norfolk CSO channel (NFK503); and
- upriver of both the Norfolk CSO and Boeing storm drain channels (NFK504).

Sample station locations were selected to monitor sediment quality in those areas with the greatest potential for recontamination; two stations in the Norfolk CSO channel and one station in the Boeing storm drain channel. The upriver station was selected to provide background or reference data.

The prescribed station location coordinates are presented in Table 1 and sample locations are shown in Figure 2.

Sediment grab samples were collected from the King County research vessel *Chinook*, which is equipped with a differential global positioning system (DGPS). Coordinates, presented in Table 1, were recorded using DGPS for each of the individual grabs as the sampler contacted the river bottom. The DGPS is a satellite-based navigation system that operates using a receiver to calculate ground position by triangulating scrambled data transmitted by a constellation of satellites operated by the Department of Defense (DOD). The ship-board "differential" receiver receives both the scrambled DOD signal and "corrected" signals originating from base stations operated by various agencies including the Coast Guard and King County. System software applies the differential correction and calculates a precise, real-time navigational position.

Two composite sediment samples were obtained from each station. One sample was collected from the 0 to 2 centimeter (cm) depth stratum and the other sample was collected from the 0 to 10 cm depth stratum. Both samples at each station were composited from three separate deployments of the grab sampler. Coordinates for each grab deployment are included in Table 1.

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## 2.2 Sample Collection and Handling

Eight estuarine sediment samples were collected April 24, 2001 from the Norfolk CSO sediment remediation site. Samples were collected from both the top 2 cm and top 10 cm of sediment at each station using a stainless steel, modified, 0.1 m<sup>2</sup> Van Veen grab sampler deployed from the *Chinook* via hydrowire. Both samples at each station were composited from three separate deployments of the grab sampler. Water depth at the four sample stations ranged between 1 and 3 meter (~ 3 to 6 feet) on an ebbing to slack tide of between 2 and -0.3 feet (referenced to mean lower low water). Between 11 and 16 cm of sediment was recovered in each grab, allowing collection of a sample aliquot from the top 10 cm without sampling sediment that had touched the sides or bottom of the grab sampler.

Samples were comprised of sediment aliquots collected from three individual grabs at each station with an equal amount of material collected from each grab. The sediment aliquot for the 0 to 2 cm depth stratum was collected from one side of each grab using a 200 cm<sup>2</sup> stainless-steel "cookie cutter." The sediment aliquot for the 0 to 10 cm depth stratum was collected from the other side of each grab using a stainless-steel spoon. Each of the aliquots were placed into separate stainless-steel bowls, covered with foil, and placed into an ice-filled cooler between grab deployments. After collecting aliquots from three grabs, the sediment sample was thoroughly homogenized and sample aliquots split out into pre-labeled containers. Sample containers were supplied by the King County Environmental Laboratory and were pre-cleaned according to analytical specifications.

Two sets of sample compositing equipment were dedicated to each station, precluding the need for decontamination of the field gear. The Van Veen grab sampler was decontaminated between stations by scrubbing with a brush and river water followed by a thorough *in situ* rinsing.

Samples were stored in ice-filled coolers from the time of collection until delivery to the King County Environmental Laboratory. Samples were delivered under chain-of-custody and were maintained as such throughout the analytical process. Samples were stored frozen (-18°C) by the laboratory until analysis with the exception of samples for particle size distribution (PSD) analysis. PSD samples were stored refrigerated at approximately 4°C. All analyses were conducted by the King County Environmental Laboratory with the exception of PSD, which was analyzed at Rosa Environmental and Geotechnical Laboratory, a subcontracted laboratory accredited by Ecology.

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## 3 SAMPLE ANALYSIS

The eight estuarine sediment samples were submitted for analysis of conventional, metal, and organic parameters. This section describes the type of analyses performed, as well as analytical methodologies used and the associated quality assurance/quality control (QA/QC) procedures followed. Analyses were selected to allow comparison of sediment data to the SMS sediment chemical criteria found in Tables 1 and 3 of Chapter 173-204 WAC (Ecology, 1995).

### 3.1 Conventionals

Conventional analyses included percent solids, total organic carbon (TOC), and PSD. Percent solids and TOC analyses were performed to provide data necessary to normalize sediment data to dry weight and organic carbon, respectively. TOC analysis also allows evaluation of possible organic enrichment at the site over time. Percent solids analysis was performed following SM 2540-G, gravimetric determination and TOC analysis was performed following EPA Method 9060, high-temperature combustion with infrared spectroscopy. PSD analysis allows evaluation of the gross physical characteristics of the backfill material and any changes imparted by sedimentation. PSD analysis was performed according to method ASTM D422, a combination of sieve and hydrometer analyses.

### 3.2 Metals

Metal analyses included 12 priority pollutant metals, as well as the crustal metals aluminum, iron, and manganese (see Appendix A). SMS regulates eight of the metals included in this suite of analytes; arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc. Metal analysis allows assessment of potential recontamination at the site over time. With the exception of mercury, all metal analyses were performed following EPA Method 3050A/6010B; strong-acid digestion with inductively coupled plasma optical emission spectroscopy. Mercury was analyzed according to EPA Method 245.5, cold vapor atomic absorption spectroscopy.

### 3.3 Organics

Organic analyses included base/neutral/acid extractable semivolatile compounds (BNAs) and PCBs (see Appendix A). Organic analysis also allows assessment of potential recontamination to the site over time, especially by PCBs and phthalates. BNA analysis was performed following EPA Method 3550B/8270C (SW-846), gas chromatography with mass spectroscopy (GC/MS). PCBs were analyzed by EPA Method 3550B/8082 (SW-846), gas chromatography with electron capture detection (GC/ECD). This suite of analytes included all organic compounds regulated under SMS.

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### **3.4 Quality Assurance/Quality Control (QA/QC)**

All analyses were performed following guidance recommended under Puget Sound Protocols (PSEP 1986, 1996b, and 1996c) including associated QA/QC practices. Laboratory QA/QC practices produced data of sufficient quality to pass QA1 review. Analytical data were reviewed following QA1 guidelines (Ecology, 1989) and flagged with data qualifiers where appropriate. A comprehensive report of analytical data, including qualifier flags is included as Appendix A. The QA1 review narrative is included as Appendix B.

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## 4 ANALYTICAL RESULTS

This section discusses analytical results for the eight estuarine sediment samples collected from the Norfolk CSO sediment remediation site and compares the data to sediment criteria specified under SMS (Ecology, 1995). Tables in this section summarize and compare the data to both Sediment Quality Standards (SQS) and Cleanup Screening Levels (CSL)

### 4.1 Particle Size Distribution (PSD)

PSD results are summarized in Table 2. PSD results indicate that there has been little overall change in the basic structure of the backfill material over the 0 to 10 cm depth stratum at stations NFK502 and NFK503. The samples collected from the 0 to 10 cm depth stratum at stations NFK502 and NFK503 were comprised of 90.7 and 97.0% sand, respectively. The samples collected from 0 to 10 cm depth stratum at stations NFK501 and NFK504, however, showed increased fine materials over the samples between April 1999 and April 2001. Percent sand content for the 0 to 10 cm depth stratum samples collected from stations NFK501 and NFK 504 was 78.8 and 65.4%, respectively. Three of the four samples collected from the 0 to 2 cm depth stratum also contained higher percentages of fine material, perhaps indicating some recently deposited silts and clays. The sample collected from the 0 to 2 cm depth stratum at station NFK503 continued to be sandy, with a sand content of 95.9%.

### 4.2 Conventional

Conventional analytical results are summarized in Table 3 and include percent solids, used to calculate dry-weight sediment concentrations of metal and organic data and TOC, used to normalize certain organic parameters to organic carbon content.

Percent solids results ranged from 52.7 to 74.7%. TOC concentrations in the 0 to 2 cm depth stratum samples ranged from 2,770 to 15,600 milligrams per kilogram (mg/Kg) dry weight, or ~ 0.3 to 1.6%. TOC concentrations in the 0 to 10 cm depth stratum samples ranged from 3,600 to 9,080 mg/Kg, or ~ 0.4 to 0.9%.

### 4.3 Metals

Sediment metal analytical results are summarized in Table 4. Metals data have been normalized to dry weight for comparison to SMS chemical criteria.

Arsenic, cadmium, and silver were not detected in any samples collected during this monitoring event. Reported concentrations of all other metals (Appendix A) were at levels indicative of natural, area-wide crustal concentrations (Dexter et al, 1981). Metal concentrations or method detection limit (MDL) values for those metals regulated under SMS were all below SQS chemical criteria. Comparison of metals data at both the 0 to 2 and 0 to 10 cm depth strata show very little change in metals concentrations over the first two years of the monitoring program.

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## 4.4 Organics

Organic analytical results are summarized in Tables 5, 6, and 7. Data for ionic organic compounds have been normalized to dry weight for comparison to SMS sediment criteria and are presented in Table 5.

Data for non-ionic organic compounds have been normalized to organic carbon and are presented in Table 6 for comparison to the SQS and CSL. Normalization to organic carbon can produce biased results, however, when the organic carbon content of the sample is very low (Ecology, 1992). When the organic carbon content of a sample is near 0.1 or 0.2% (1,000 to 2,000 mg/Kg dry weight), even background concentrations of certain organic compounds can exceed the SQS or CSL.

For sediment with a TOC content less than 0.5% (5,000 mg/Kg dry weight), Ecology recommends comparing dry weight-normalized, non-ionic organic data to Puget Sound lowest apparent effects thresholds (LAET) and second lowest apparent lowest effects thresholds (2LAET) (EPA, 1988), which are considered to be equivalent to the SQS and CSL values, respectively. This comparison allows a more appropriate evaluation of sediment quality relative to organic compounds (Ecology, 1992). Table 7 presents this comparison.

### 4.4.1 Ionic Organic Compounds

Benzoic acid was detected in all eight samples at concentrations ranging from 67.6 to 299 micrograms per kilogram ( $\mu\text{g/Kg}$ ). These concentrations are below the SQS/CSL criterion of 650  $\mu\text{g/Kg}$  and are similar to concentrations detected during previous monitoring events. No other ionic organic chemicals were detected in any of the samples collected during this monitoring event.

### 4.4.2 Non-Ionic Organic Compounds Compared to SQS/CSL Criteria

Organic carbon values in samples collected during this monitoring event ranged from 0.3 to 1.6%. Samples with organic carbon content less than 0.5% include the sample collected from the 0 to 10 cm depth stratum at station NFK502 and both samples collected from station NFK503.

#### 4.4.2.1 Low-Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs)

Anthracene was detected in all four samples collected from the 0 to 2 cm depth stratum. Organic carbon-normalized anthracene concentrations were all less than 1% of the SQS criterion of 220 mg/Kg organic carbon (OC). Phenanthrene was detected in samples collected from the 0 to 2 cm depth stratum at all four stations as well as three of four samples collected from the 0 to 10 cm depth stratum. Phenanthrene concentrations are all less than 10% of the SQS criterion of 100 mg/Kg organic carbon (OC). No other LPAH compounds were detected in samples collected during this monitoring event.

#### 4.4.2.2 High-Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs)

One or more HPAH compounds were detected in both samples collected from all four stations. Organic carbon-normalized HPAH concentrations were typically less than 10% of the SQS criteria. Concentrations of HPAH compounds have shown some variation over the four monitoring events although the concentrations detected have all been below SQS criteria. The station in the Norfolk CSO channel (NFK501) had the greatest number of HPAH compounds detected but the total HPAH value was still less than 10% of the associated SQS value.

#### 4.4.2.3 Chlorobenzenes

Chlorobenzene compounds were not detected in any samples collected during this monitoring event. All chlorobenzene MDL values were lower than associated sediment chemical criteria, both organic carbon- and dry weight-normalized.

#### 4.4.2.4 Phthalates

Bis(2-ethylhexyl) phthalate was detected in all eight samples collected during this monitoring event. Concentrations ranging from 24.9 to 42.7 mg/Kg OC were reported in samples collected from the three stations with an organic carbon content greater than 0.5%. These concentrations are all less than the SQS of 47 mg/Kg OC with the low value at 53% of the SQS and the high value at 91% of the SQS. Bis(2-ethylhexyl) phthalate was also detected in the method blank associated with this group of samples at a concentration of 14.5 µg/Kg dry weight (see Appendix B). Normalized to the range of organic carbon concentrations found in these samples, method blank concentrations of bis(2-ethylhexyl) phthalate would be 0.93 to 5.23 mg/Kg OC. Bis(2-ethylhexyl) phthalate concentrations in both samples collected from the Boeing storm drain channel (NFK503) were less than five times the method blank concentration and should be discounted as highly biased. Other bis(2-ethylhexyl) phthalate concentrations are legitimate as reported, however, they should be viewed with the possibility of some contribution to the overall concentration from laboratory contamination.

Di-N-butyl phthalate was detected in all eight samples collected during this monitoring event, however, this compound was also detected in the laboratory method blank. All sample concentrations were less than five times the method blank concentration and, as a result, should be disregarded.

Butyl benzyl phthalate was detected in both samples collected from the Norfolk CSO channel (NFK501), the combined channel delta (NFK502), and the upriver reference station (NFK504) at concentrations ranging from 2.24 to 6.63 mg/Kg OC. The concentrations detected in the samples collected from the 0 to 10 cm depth stratum at stations NFK501 and NFK502 (6.63 and 5.03 mg/Kg OC, respectively) exceeded the SQS for butyl benzyl phthalate of 4.9 mg/Kg OC. Both of these reported concentrations, however, are well below the butyl benzyl phthalate CSL of 64 mg/Kg OC. Butyl benzyl phthalate was not detected in the sample collected from the Boeing storm drain channel.

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#### 4.4.2.5 Miscellaneous Compounds

Dibenzofuran, hexachlorobutadiene, and N-nitrosodiphenylamine were not detected in any samples collected during this monitoring event. MDL values for these compounds were all below associated SQS criteria.

#### 4.4.2.6 PCBs

PCBs (as total Aroclors®) were detected in all eight samples collected during this monitoring event. The highest reported PCB concentrations were detected in samples collected from the Boeing storm drain channel (NFK503). The organic carbon content of both samples collected from station NFK503 is less than 0.5%, therefore, comparison to PCB chemical criteria should be made to dry weight-normalized LAET values. The PCB concentrations of 1,880 µg/Kg DW (0 to 2 cm sample) and 1,330 µg/Kg DW (0 to 10 cm sample) detected in the Boeing storm drain channel both exceed the 2LAET criterion value of 1,000 µg/Kg DW.

The organic carbon content at the other three stations was greater than 0.5%, therefore, comparison to PCB chemical criteria should be made to organic carbon-normalized SQS/CSL values. The PCB concentrations of 24.8 mg/Kg OC (0 to 2 cm sample) and 18.9 mg/Kg OC (0 to 10 cm sample) detected at the combined channel delta station (NFK502) both exceed the SQS criterion value of 12 mg/Kg OC. PCB concentrations detected in samples collected from the Norfolk CSO channel (NFK501) and the upriver reference station (NFK504) were all less than the SQS criterion value.

#### ***4.4.3 Non-Ionic Organic Compounds Compared to LAET/2LAET Criteria***

The dry weight-normalized MDL range of 27 to 31 µg/Kg for N-nitrosodiphenylamine exceeded the LAET criterion of 28 µg/Kg for six of eight samples collected during this monitoring event. N-nitrosodiphenylamine was not detected in any of the samples.

All dry weight-normalized, detected concentrations of LPAHs, HPAHs, and phthalates were below LAET criteria.

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## 5 FUTURE MONITORING

Sampling and analysis completed in April 2001 was performed to assess surface sediment conditions of the backfill material two years after placement at the Norfolk remediation site. Future monitoring events will occur on an annual basis, with the next monitoring event scheduled for April 2002. Station locations will remain the same unless the CSO and storm drain discharge channels change significantly over the course of the monitoring period.

All subsequent monitoring events will include collection of two discrete samples from each of the four established locations. One sample will be collected from the top 2 cm of sediment and analyzed to evaluate the chemical characteristics of recently deposited material. Another sample will be collected from the top 10 cm to evaluate the chemical characteristics of the sediment over the entire biologically active zone. The remainder of the five-year monitoring schedule is shown below.

- April 2002 - Year three monitoring event.
- April 2003 - Year four monitoring event.
- April 2004 - Year five (final) monitoring event.

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## 6 SUMMARY AND CONCLUSIONS

Eight estuarine sediment samples were collected in April 2001 from the Norfolk CSO sediment remediation site, two years after completion of remedial activities. Samples were collected from the surface of backfill material placed at the site and analytical results were compared to baseline chemical conditions of the backfill material to evaluate possible recontamination at the site.

Samples were collected from two depth strata at each of four stations: one sample collected from the 0 to 2 cm depth stratum to evaluate chemical concentrations in recently deposited sediment; and one sample collected from the 0 to 10 cm depth stratum to evaluate sediment chemical concentrations over the entire biologically active zone. Analytes included sediment conventionals along with metal and organic parameters required under SMS criteria.

To allow comparison of analytical results from the four monitoring events completed to date, dry weight-normalized data from 0 to 10 cm depth stratum samples from the April 1999, October 1999, April 2000, and April 2001 monitoring events are presented in Table 8. These analytical results show that, after two years, conditions of the backfill material within the 0 to 10 cm depth stratum can be characterized by:

- an increase in organic carbon content at all stations except the Boeing storm drain channel station (NFK503);
- little or no change in grain size distribution at the combined channel delta station (NFK502), an increase in fine materials at the Norfolk CSO channel station (NFK501) and the upriver reference station (NFK504), and a decrease in fine materials at the Boeing storm drain station (NFK503);
- little or no change in metal concentrations at all four stations;
- the presence of low concentrations of a few PAH compounds at some stations, varying both spatially and temporally, with no indication of a trend toward increasing concentrations;
- the presence of butyl benzyl phthalate at the Norfolk CSO channel station (NFK501), the combined channel delta station (NFK502), and the upriver reference station (NFK504), however, this chemical was not detected during previous monitoring events;
- the presence of measurable concentrations of bis(2-ethylhexyl) phthalate at the Norfolk CSO channel station (NFK501), the combined channel delta station (NFK502), and the upriver reference station (NFK504), however, this chemical was previously not quantifiable due to laboratory sample contamination; and
- increasing concentrations of PCBs at all four stations, however, concentrations of this chemical increased dramatically at the Boeing storm drain channel station (NFK503) between the last two monitoring events (April 2000 and April 2001).

A comparison of dry weight-normalized analytical results from the 0 to 2 cm depth stratum between the October 1999, April 2000, and April 2001 monitoring events is presented in Table 9. These analytical results show that, after two years, conditions of the backfill material within the 0 to 2 cm depth stratum can be characterized by:

- an increase in organic carbon content at the Norfolk CSO channel station (NFK501) and the upriver reference station (NFK504);
- a steady decrease in fine materials at the combined channel delta station (NFK502) and the Boeing storm drain channel station (NFK503) and some temporal variability in the quantity of fine materials at the Norfolk CSO channel station (NFK501) and the upriver reference station (NFK504);
- consistent concentrations of metals at area background levels;
- more frequently-detected PAH compounds, although at concentrations well below the SQS (typically, less than 10% of the SQS value);
- the presence of butyl benzyl phthalate at the Norfolk CSO channel station (NFK501), the combined channel delta station (NFK502), and the upriver reference station (NFK504), however, this chemical was not detected during previous monitoring events;
- the presence of measurable concentrations of bis(2-ethylhexyl) phthalate at the Norfolk CSO channel station (NFK501), the combined channel delta station (NFK502), and the upriver reference station (NFK504), however, this chemical was previously not quantifiable due to laboratory sample contamination; and
- increasing concentrations of PCBs at all four stations, however, concentrations increased dramatically at the Boeing storm drain channel station (NFK503).

Metals concentrations throughout the backfill material at the Norfolk sediment remediation site continue to be detected at concentrations indicative of regional background levels (Dexter et al, 1981). Cadmium and silver have rarely been detected in samples collected from the site and arsenic and mercury have been detected infrequently. Discharges from the Norfolk CSO and Boeing storm drain do not appear to be impacting metals' concentrations in the backfill material.

While low levels of bis(2-ethylhexyl) phthalate have been detected in samples collected during previous monitoring events, the concentrations have not been statistically different from concentrations detected in associated analytical method blanks. Bis(2-ethylhexyl) phthalate concentrations detected in samples collected during the April 2001 monitoring event, however, are significantly higher than method blank concentrations at the Norfolk CSO channel station (NFK501), the combined channel delta station (NFK502), and the upriver reference station (NFK504). Organic carbon-normalization of bis(2-ethylhexyl) phthalate concentrations is appropriate at these three stations given the TOC concentrations of 0.5 to 1.6%. Organic carbon-normalized bis(2-ethylhexyl) phthalate concentrations at these three stations range from 24.9 to 42.7 mg/Kg OC. These concentrations are all less than the SQS chemical criterion of 47 mg/Kg OC, however, the concentration detected at the Norfolk CSO channel station (NFK501) is 91% of the SQS, the concentration detected at the combined channel delta station (NFK502) is 67% of the SQS, and the concentration detected at the upriver reference station (NFK504) is 53% of the SQS.

Butyl benzyl phthalate was detected at the Norfolk CSO channel station (NFK501), the combined channel delta station (NFK502), and the upriver reference station (NFK504) at organic carbon-normalized concentrations of 2.24 to 6.63 mg/Kg OC. Butyl benzyl phthalate concentrations in the samples collected from the 0 to 10 cm depth stratum at stations NFK501 (6.63 mg/Kg OC) and NFK502 (5.03mg/Kg OC) exceed the SQS chemical criterion

of 4.9 mg/Kg OC. This compound has not been detected during previous monitoring events and has not been detected at the Boeing storm drain channel station. The low concentrations present and lack of continuous temporal data make it difficult to assess a source at this point, however, there does appear to be a slight concentration gradient for butyl benzyl phthalate toward the Norfolk CSO.

Several HPAH compounds were detected for the first time during the April 2001 monitoring event. Two of these compounds, anthracene and indeno(1,2,3-c,d)pyrene, appear to be the result of significant improvements in analytical method detection limits. HPAH data do not appear to be following any spatial or temporal trends with no apparent concentration gradients. Concentrations of HPAHs detected in samples collected during the April 2001 monitoring event continue to be well below the SQS or LAET with most values less than 10% of the SQS.

Samples collected from two of four stations during the April 2001 monitoring event have PCB concentrations that exceed SMS criteria. The highest PCB concentrations were detected in the samples collected from the Boeing storm drain channel station (NFK503) and the second highest PCB concentrations were detected in the samples collected from the combined channel delta station (NFK502).

The organic carbon content of the samples collected from the Boeing storm drain channel (0.28 and 0.36%) indicates that dry weight-normalized PCB concentrations should be compared to LAET criteria. Dry weight-normalized PCB concentrations in both depth strata at station NFK503 exceed the 2LAET chemical criterion, which is equivalent to the CSL. The Boeing storm drain channel station is located upstream of the combined channel delta station (NFK502), which had a lower PCB concentration; exceeding the SQS but not the CSL in samples collected from both depth strata. The concentration gradient indicates PCBs on the backfill material are coming from the direction of the Boeing storm drain.

PCB concentrations detected at the Norfolk CSO channel station (NFK501) and the upriver reference station (NFK504) were well below the SQS for both depth strata.

A similar pattern of PCB distribution was observed in samples collected at six months (October 1999) and one year (April 2000) after placement of the backfill material. A follow-up sampling event to track potential sources for the apparent PCB re-contamination of the backfill was completed in February 2000. Results from this sampling event revealed an area of high PCB concentrations (4,900 to 8,400  $\mu\text{g/Kg DW}$ ) in sediment in front of the Boeing storm drain outfall. This suggests the most likely source of PCB recontamination to the storm drain channel is the erosion of PCB-contaminated sediments adjacent to the Boeing storm drain pipe outfall (King County 2000).

Boeing conducted a source control investigation of their storm drain and found PCB concentrations that exceed the CSL (on a dry weight-basis) in storm drain sediment (Boeing, 2001), however, Boeing discounts the storm drain as a possible PCB source to the storm drain channel and backfill material. Boeing acknowledges the presence of high PCB

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concentrations in sediment in front of the storm drain outfall but states that this is not from their storm drain.

### ***Summary of Issues by Monitoring Station***

Norfolk CSO Channel (Station NFK501) – The concentration of bis(2-ethylhexyl) phthalate detected in the 0 to 2 cm depth stratum is 91% of the SQS. The reported concentration of this compound does not appear to be compromised by laboratory contamination. The concentration of butyl benzyl phthalate detected in the 0 to 10 cm depth stratum exceeds the SQS. Phthalates are present in both CSO and separated storm water but the greatest potential for recontamination at the Norfolk cleanup site was predicted to be from separated storm water discharged from the Norfolk CSO outfall (EBDRP, 1996).

Combined Channel Delta (Station NFK502) – The concentration of butyl benzyl phthalate detected in the 0 to 10 cm depth stratum exceeds the SQS. The concentrations of PCBs detected in both depth strata exceed the SQS. It appears that PCBs detected at this station originate from the Boeing storm drain channel and phthalates may be related to the Norfolk CSO outfall.

Boeing Storm Drain Channel (Station NFK503) – The concentrations of PCBs detected in both depth strata exceed the 2LAET, which is considered equivalent to the CSL value when organic carbon concentrations are less than 0.5%. The greatest source of PCB recontamination appears to be the erosion of PCB-contaminated sediment directly in front of the Boeing storm drain. Boeing believes this is not related to their storm drain so the issue has been referred to the project regulatory agencies.

Upriver Reference (Station NFK504) – No chemicals of concern at this time, although reportable concentrations of bis(2-ethylhexyl) phthalate and butyl benzyl phthalate are present for the first time in samples collected during this monitoring event.

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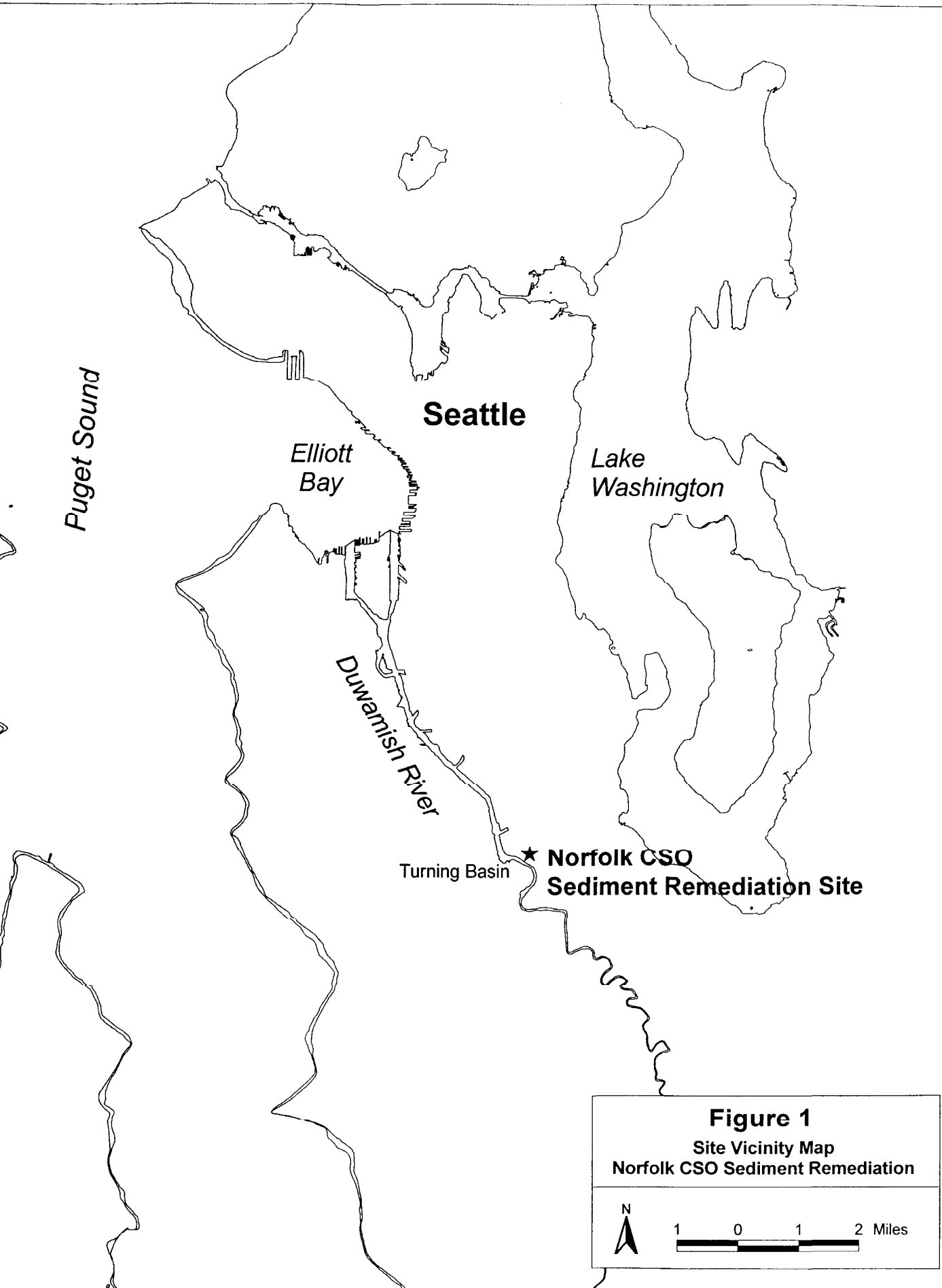
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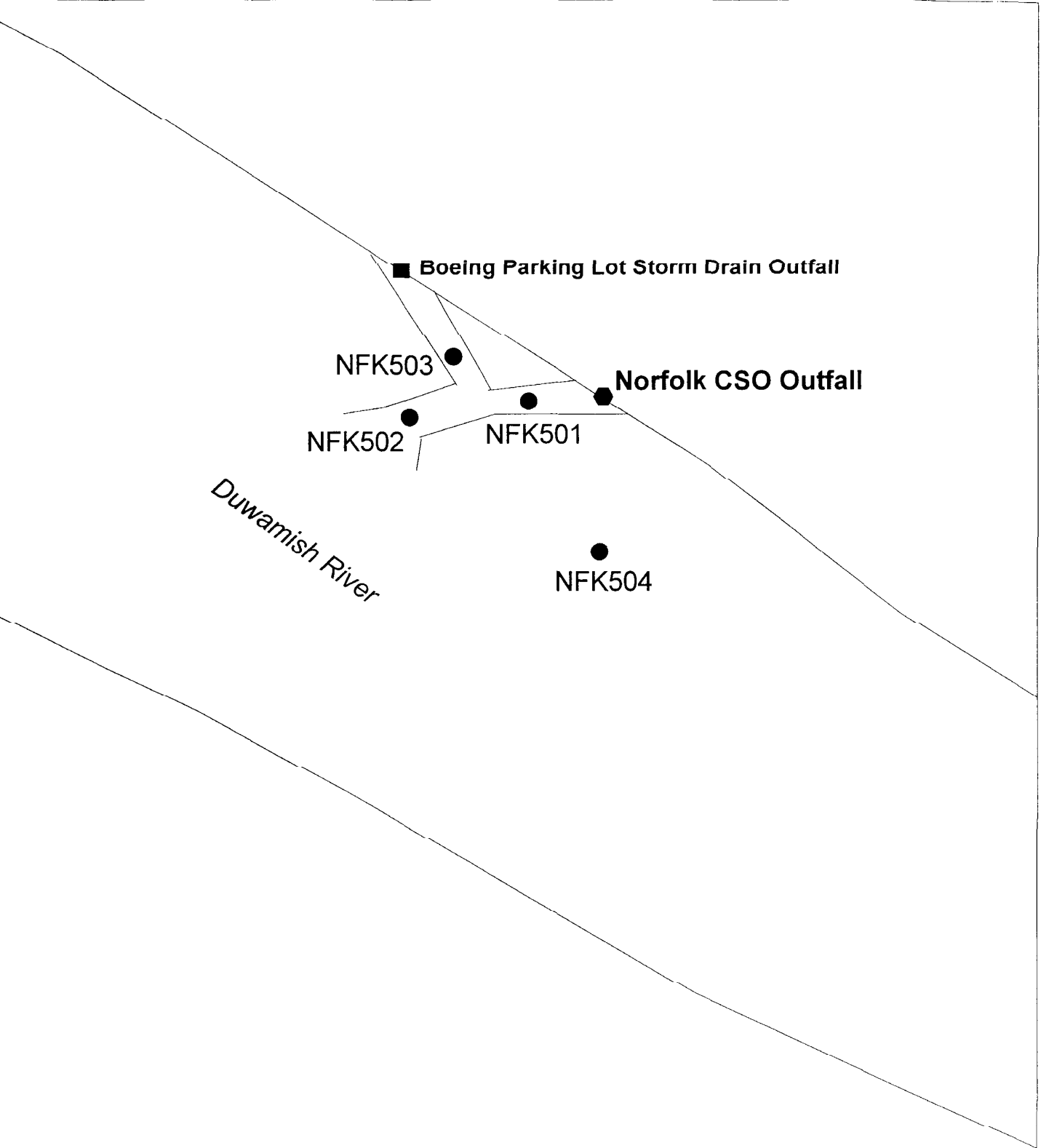
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**Figure 1**  
Site Vicinity Map  
Norfolk CSO Sediment Remediation



1 0 1 2 Miles



**Figure 2**  
Site Map with Sample Locations  
Norfolk CSO Sediment Remediation

N  
40 0 40 80 Feet

**Table 1**  
**Sample Location Coordinates**  
**Norfolk CSO Sediment Remediation Project**  
**Five-Year Monitoring Program**  
**Year Two - April 2001 Monitoring Data**

<b>Station Name</b>	<b>Northing (NAD83)</b>		<b>Easting (NAD83)</b>	
NFK501 Prescribed Station	190170		1278584	
NFK501 Grab 1		190154		1278590
NFK501 Grab 2		190146		1278581
NFK501 Grab 3		190159		1278577
NFK502 Prescribed Station	190159		1278514	
NFK502 Grab 1		190154		1278509
NFK502 Grab 2		190157		1278513
NFK502 Grab 3		190157		1278514
NFK503 Prescribed Station	190195		1278544	
NFK503 Grab 1		190175		1278555
NFK503 Grab 2		190181		1278547
NFK503 Grab 3		190176		1278545
NFK504 Prescribed Station	190080		1278625	
NFK504 Grab 1		190072		1278628
NFK504 Grab 2		190077		1278624
NFK504 Grab 3		190077		1278622

**Notes**

NAD83 - North American Datum, 1983

**Table 2**  
**Particle Size Distribution**  
**Norfolk CSO Sediment Remediation Project**  
**Five-Year Monitoring Program**  
**Year Two - April 2001 Monitoring Data**

Phi Size	Class	Percent Distribution			
		NFK 501 0 - 2 cm	NFK501 0 - 10 cm	NFK502 0 - 2 cm	NFK502 0 - 10 cm
>p-2.00	Gravel	<MDL (0.1)	<MDL (0.1)	<MDL (0.1)	<MDL (0.1)
p-2.00	Gravel	<MDL (0.1)	0.6	<MDL (0.1)	<MDL (0.1)
p-1.00	Gravel	0.2	0.9	<MDL (0.1)	<MDL (0.1)
	<b>Total Gravel</b>	<b>0.2</b>	<b>1.5</b>	<b>&lt; MDL (0.1)</b>	<b>&lt; MDL (0.1)</b>
p0.00	Sand	1.8	1.8	1.0	0.7
p+1.00	Sand	16.3	15.7	19.6	19.2
p+2.00	Sand	42.6	36.5	54.5	58.9
p+3.00	Sand	9.2	11.3	11.2	9.5
p+4.00	Sand	11.6	13.5	2.8	2.4
	<b>Total Sand</b>	<b>81.5</b>	<b>78.8</b>	<b>89.1</b>	<b>90.7</b>
p+5.00	Silt	6.1	6.9	1.8	2.2
p+6.00	Silt	3.8	4.5	2.5	2.0
p+7.00	Silt	2.4	3.0	1.8	1.4
p+8.00	Silt	2.2	2.2	1.6	1.2
	<b>Total Silt</b>	<b>14.5</b>	<b>16.6</b>	<b>7.7</b>	<b>6.8</b>
p+9.00	Clay	1.5	1.5	1.2	0.9
p+10.00	Clay	1.0	0.8	0.7	0.6
<p+10.00	Clay	1.3	1.4	1.2	0.9
	<b>Total Clay</b>	<b>3.8</b>	<b>3.7</b>	<b>3.1</b>	<b>2.4</b>

Phi Size	Class	Percent Distribution			
		NFK503 0 - 2 cm	NFK503 0 - 10 cm	NFK504 0 - 2 cm	NFK504 0 - 10 cm
>p-2.00	Gravel	<MDL (0.1)	<MDL (0.1)	<MDL (0.1)	<MDL (0.1)
p-2.00	Gravel	<MDL (0.1)	<MDL (0.1)	<MDL (0.1)	0.2
p-1.00	Gravel	1.0	1.0	0.5	0.3
	<b>Total Gravel</b>	<b>1.0</b>	<b>1.0</b>	<b>0.5</b>	<b>0.5</b>
p0.00	Sand	4.9	4.1	2.8	2.1
p+1.00	Sand	28.6	32.1	21.7	15.4
p+2.00	Sand	55.7	55.0	43.3	30.4
p+3.00	Sand	5.9	5.2	6.8	6.5
p+4.00	Sand	0.8	0.6	6.1	11.0
	<b>Total Sand</b>	<b>95.9</b>	<b>97.0</b>	<b>80.7</b>	<b>65.4</b>
p+5.00	Silt	1.8	1	4.2	14.2
p+6.00	Silt	0.3	0.2	4.8	6.3
p+7.00	Silt	0.3	0.2	3.1	4.2
p+8.00	Silt	0.2	0.1	2.3	3
	<b>Total Silt</b>	<b>2.6</b>	<b>1.5</b>	<b>14.4</b>	<b>27.7</b>
p+9.00	Clay	0.1	0.2	1.6	2.2
p+10.00	Clay	0.1	<MDL (0.1)	0.9	1.1
<p+10.00	Clay	0.4	0.4	2.1	3.3
	<b>Total Clay</b>	<b>0.6</b>	<b>0.6</b>	<b>4.6</b>	<b>6.6</b>

**Notes**

<MDL (#) - Analyte not detected above the *method detection limit*. Value in parentheses is the numeric MDL.

**Table 3**  
**Sediment Conventional**  
**Norfolk CSO Sediment Remediation Project**  
**Five-Year Monitoring Program**  
**Year Two - April 2001 Monitoring Data**

<b>Conventional</b>	<b>NFK 501 0 - 2 cm</b>	<b>NFK501 0 - 10 cm</b>	<b>NFK502 0 - 2 cm</b>	<b>NKF502 0 - 10 cm</b>
Solids (%)	68.5	65.4	67.1	66.5
TOC (mg/Kg DW)	8,180	8,670	6,510	4,990

<b>Conventional</b>	<b>NFK503 0 - 2 cm</b>	<b>NFK503 0 - 10 cm</b>	<b>NFK504 0 - 2 cm</b>	<b>NFK504 0 - 10 cm</b>
Solids (%)	74.7	74.1	52.7	60.1
TOC (mg/Kg DW)	2,770	3,600	15,600	9,080

**Notes**

TOC - Total organic carbon.

mg/Kg DW - Milligrams per kilogram dry weight, based on percent solids analysis.

**Table 4**  
**Sediment Metal Concentrations**  
**Norfolk CSO Sediment Remediation Project**  
**Five-Year Monitoring Program**  
**Year Two - April 2001 Monitoring Data**

Metal	Concentration (mg/Kg DW)				SQS	CSL
	NFK501 0 - 2 cm	NFK501 0 - 10 cm	NFK502 0 - 2 cm	NFK502 0 - 10 cm		
Arsenic	<MDL (3.6)	<MDL (3.8)	<MDL (3.6)	<MDL (3.6)	57	93
Cadmium	<MDL (0.22)	<MDL (0.23)	<MDL (0.21)	<MDL (0.23)	5.1	6.7
Chromium	16.1	17.4	16.7	13.3	260	270
Copper	17.2	18.5	15.5	13.1	390	390
Lead	11.6	11.8	9.39	9.62	450	530
Mercury	0.069	0.043	0.031	<MDL (0.030)	0.41	0.59
Silver	<MDL (0.29)	<MDL (0.31)	<MDL (0.28)	<MDL (0.30)	6.1	6.1
Zinc	56.6	59.0	51.6	46.5	410	960

Metal	Concentration (mg/Kg DW)				SQS	CSL
	NFK503 0 - 2 cm	NFK503 0 - 10 cm	NFK504 0 - 2 cm	NFK504 0 - 10 cm		
Arsenic	<MDL (3.3)	<MDL (3.2)	<MDL (4.7)	<MDL (4.2)	57	93
Cadmium	<MDL (0.20)	<MDL (0.20)	<MDL (0.28)	<MDL (0.25)	5.1	6.7
Chromium	13.9	12.0	21.1	17.8	260	270
Copper	11.4	12.9	24.9	18.8	390	390
Lead	7.36	7.83	18.0	13.8	450	530
Mercury	<MDL (0.025)	0.10	0.072	0.038	0.41	0.59
Silver	<MDL (0.27)	<MDL (0.26)	<MDL (0.38)	<MDL (0.33)	6.1	6.1
Zinc	43.4	46.4	68.3	60.6	410	960

**Notes**

mg/Kg DW - Milligrams per kilogram dry weight, based on percent solids analysis.

<MDL (#) - Analyte not detected above the *method detection limit*. Value in parentheses is the numeric MDL.

**Table 5**  
**Sediment Ionic Organic Concentrations**  
**Norfolk CSO Sediment Remediation Project**  
**Five-Year Monitoring Program**  
**Year Two - April 2001 Monitoring Data**

Ionic Organics	Concentration (µg/Kg DW)				SQS	CSL
	NFK501 0 - 2 cm	NFK501 0 - 10 cm	NFK502 0 - 2 cm	NFK502 0 - 10 cm		
Benzoic Acid	299	122	162	152	650	650
Benzyl Alcohol	<MDL (8.8)	<MDL (9.2)	<MDL (8.9)	<MDL (9.0)	57	73
2,4-Dimethylphenol	<MDL (10)	<MDL (11)	<MDL (10)	<MDL (11)	29	29
2-Methylphenol	<MDL (28)	<MDL (29)	<MDL (28)	<MDL (29)	63	63
4-Methylphenol	<MDL (23)	<MDL (24)	<MDL (24)	<MDL (24)	670	670
Pentachlorophenol	<MDL (7.3)	<MDL (7.6)	<MDL (7.5)	<MDL (7.5)	360	690
Phenol	<MDL (13)	<MDL (14)	<MDL (13)	<MDL (14)	420	1,200

Ionic Organics	Concentration (µg/Kg DW)				SQS	CSL
	NFK503 0 - 2 cm	NFK503 0 - 10 cm	NFK504 0 - 2 cm	NFK504 0 - 10 cm		
Benzoic Acid	80.9	67.6	268	168	650	650
Benzyl Alcohol	<MDL (8.0)	<MDL (8.1)	<MDL (11)	<MDL (10)	57	73
2,4-Dimethylphenol	<MDL (9.4)	<MDL (9.4)	<MDL (13)	<MDL (12)	29	29
2-Methylphenol	<MDL (25)	<MDL (26)	<MDL (36)	<MDL (32)	63	63
4-Methylphenol	<MDL (21)	<MDL (22)	<MDL (30)	<MDL (27)	670	670
Pentachlorophenol	<MDL (6.7)	<MDL (6.7)	<MDL (9.5)	<MDL (8.3)	360	690
Phenol	<MDL (12)	<MDL (12)	<MDL (17)	<MDL (15)	420	1,200

**Notes**

µg/Kg DW - Micrograms per kilogram dry weight, based on percent solids analysis.

<MDL (#) - Analyte not detected above the *method detection limit*. Value in parentheses is the numeric MDL.

**Table 6**  
**Sediment Non-Ionic Organic Concentrations (Organic Carbon Normalized)**  
**Norfolk CSO Sediment Remediation Project**  
**Five-Year Monitoring Program**  
**Year Two - April 2001 Monitoring Data**

	Concentration (mg/Kg OC)					
	NFK501 0 - 2 cm TOC 0.82%	NFK501 0 - 10 cm TOC 0.87%	NFK502 0 - 2 cm TOC 0.65%	NFK502 0 - 10 cm TOC 0.50%		
Non-Ionic Organics					SQS	CSL
<b>LPAHs</b>						
Acenaphthene	<MDL (1.3)	<MDL (1.2)	<MDL (1.6)	<MDL (2.1)	16	57
Acenaphthylene	<MDL (2.7)	<MDL (2.6)	<MDL (3.4)	<MDL (4.5)	66	66
Anthracene	0.98	1.2	1.1	1.4	220	1,200
Fluorene	<MDL (2.3)	<MDL (2.3)	<MDL (3.0)	<MDL (3.9)	23	79
2-Methylnaphthalene	<MDL (2.5)	<MDL (2.5)	<MDL (3.2)	<MDL (4.2)	38	64
Naphthalene	<MDL (2.5)	<MDL (2.5)	<MDL (3.2)	<MDL (1.2)	99	170
Phenanthrene	7.98	5.40	6.00	6.33	100	480
Total LPAH	9.0	6.6	7.1	7.7	370	780
<b>HPAHs</b>						
Benzo(a)anthracene	7.39	4.71	5.81	7.62	110	270
Benzo(a)pyrene	11.3	7.09	8.72	4.91	99	210
Benzofluoranthenes (Total)	24.2	15.9	19.6	23.5	230	450
Benzo(g,h,i)perylene	3.04	2.12	<MDL (1.8)	<MDL (2.4)	31	78
Chrysene	10.0	7.16	7.53	8.40	110	460
Dibenzo(a,h)anthracene	<MDL (1.3)	<MDL (1.2)	<MDL (1.6)	<MDL (2.1)	12	33
Fluoranthene	19.8	14.3	16.8	20.0	160	1,200
Indeno(1,2,3-c,d)pyrene	4.11	2.47	3.43	<MDL (2.7)	34	88
Pyrene	15.3	11.0	12.2	10.2	1,000	1,400
Total HPAH	95.1	64.8	74.1	74.6	960	5,300
<b>Chlorobenzenes</b>						
1,2-Dichlorobenzene	<MDL (0.046)	<MDL (0.046)	<MDL (0.060)	<MDL (0.078)	2.3	2.3
1,4-Dichlorobenzene	<MDL (0.023)	<MDL (0.023)	<MDL (0.030)	<MDL (0.039)	3.1	9
Hexachlorobenzene	<MDL (0.12)	<MDL (0.12)	<MDL (0.15)	<MDL (0.20)	0.38	2.3
1,2,4-Trichlorobenzene	<MDL (0.046)	<MDL (0.046)	<MDL (0.060)	<MDL (0.078)	0.81	1.8
<b>Phthalates</b>						
Bis(2-ethylhexyl) Phthalate	42.7	28.4	31.6	38.6	47	78
Butyl Benzyl Phthalate	3.63	6.63	3.89	5.03	4.9	64
Di-N-butyl Phthalate	5.73, B	5.03, B	5.01, B	6.11, B	220	1,700
Di-N-octyl Phthalate	<MDL (1.4)	<MDL (1.4)	<MDL (1.8)	<MDL (2.4)	58	4,500
Diethyl Phthalate	<MDL (1.1)	<MDL (1.1)	<MDL (1.4)	<MDL (1.8)	61	110
Dimethyl Phthalate	<MDL (2.0)	<MDL (1.9)	<MDL (2.5)	<MDL (3.3)	53	53
<b>Miscellaneous Compounds</b>						
Dibenzofuran	<MDL (2.5)	<MDL (2.5)	<MDL (3.2)	<MDL (4.2)	15	58
Hexachlorobutadiene	<MDL (0.13)	<MDL (0.13)	<MDL (0.17)	<MDL (0.23)	3.9	6.2
N-Nitrosodiphenylamine	<MDL (3.6)	<MDL (3.5)	<MDL (4.6)	<MDL (6.0)	11	11
<b>PCBs</b>						
Total PCBs	7.4	4.09	24.8	18.9	12	65

**Notes**

mg/Kg OC - Milligrams per kilogram organic carbon, based on total organic carbon analysis.

<MDL (#) Analyte not detected above the *method detection limit*. Value in parentheses is the numeric MDL.

TOC % - Percent total organic carbon on a dry weight basis, based on total solids analysis.

Shaded Cell with Double Border - Detected concentration exceeds the SQS and/or CSL.

B - Compound detected in laboratory method blank. Sample concentration is less than 5 times the method blank concentration and should be discounted.

Table 6 (cont.)

**Sediment Non-Ionic Organic Concentrations (Organic Carbon Normalized)**  
**Norfolk CSO Sediment Remediation Project**  
**Five-Year Monitoring Program**  
**Year Two - April 2001 Monitoring Data**

	Concentration (mg/Kg OC)					
	NFK503 0 - 2 cm TOC 0.28%	NFK503 0 - 10 cm TOC 0.36%	NFK504 0 - 2 cm TOC 1.56%	NFK504 0 - 10 cm TOC 0.91%		
Non-Ionic Organics					SQS	CSL
LPAHs						
Acenaphthene	<MDL (3.4)	<MDL (2.6)	<MDL (0.85)	<MDL (1.3)	16	57
Acenaphthylene	<MDL (7.2)	<MDL (5.6)	<MDL (1.8)	<MDL (2.7)	66	66
Anthracene	<MDL (1.9)	<MDL (1.5)	<MDL (0.49)	<MDL (0.73)	220	1,200
Fluorene	<MDL (6.3)	<MDL (4.9)	<MDL (1.6)	<MDL (2.4)	23	79
2-Methylnaphthalene	<MDL (6.8)	<MDL (5.2)	<MDL (1.7)	<MDL (2.6)	38	64
Naphthalene	<MDL (6.8)	<MDL (5.2)	<MDL (1.7)	<MDL (2.6)	99	170
Phenanthrene	3.0	<MDL (1.5)	1.00	1.2	100	480
Total LPAH	3.0	<MDL	1.00	1.2	370	780
HPAHs						
Benzo(a)anthracene	2.94	0.82	1.59	1.98	110	270
Benzo(a)pyrene	<MDL (1.4)	<MDL (1.1)	<MDL (0.36)	<MDL (0.55)	99	210
Benzo(a)fluoranthene (Total)	5.9	<MDL (1.1)	2.15	2.6	230	450
Benzo(g,h,i)perylene	<MDL (3.9)	<MDL (3.0)	<MDL (0.97)	<MDL (1.5)	31	78
Chrysene	2.9	<MDL (1.5)	1.10	0.90	110	460
Dibenzo(a,h)anthracene	<MDL (3.4)	<MDL (2.6)	<MDL (0.85)	<MDL (1.3)	12	33
Fluoranthene	8.84	<MDL (3.0)	3.22	3.02	160	1,200
Indeno(1,2,3-c,d)pyrene	<MDL (4.3)	<MDL (3.4)	<MDL (1.1)	<MDL (1.6)	34	88
Pyrene	2.1	<MDL (1.5)	<MDL (0.49)	<MDL (0.73)	1,000	1,400
Total HPAH	23	0.82	8.06	8.5	960	5,300
Chlorobenzenes						
1,2-Dichlorobenzene	<MDL (0.13)	<MDL (0.097)	<MDL (0.032)	<MDL (0.048)	2.3	2.3
1,4-Dichlorobenzene	<MDL (0.063)	<MDL (0.049)	<MDL (0.016)	<MDL (0.024)	3.1	9
Hexachlorobenzene	<MDL (0.32)	<MDL (0.25)	<MDL (0.080)	<MDL (0.12)	0.38	2.3
1,2,4-Trichlorobenzene	<MDL (0.13)	<MDL (0.097)	<MDL (0.032)	<MDL (0.048)	0.81	1.8
Phthalates						
Bis(2-ethylhexyl) Phthalate	18.4, B	11.8, B	24.9	36.4	47	78
Butyl Benzyl Phthalate	<MDL (2.9)	<MDL (2.2)	2.24	3.08	4.9	64
Di-N-butyl Phthalate	11.4, B	9.40, B	3.60, B	4.32, B	220	1,700
Di-N-octyl Phthalate	<MDL (3.9)	<MDL (3.0)	<MDL (0.97)	<MDL (1.5)	58	4,500
Diethyl Phthalate	<MDL (2.9)	<MDL (2.2)	<MDL (0.73)	<MDL (1.1)	61	110
Dimethyl Phthalate	<MDL (5.3)	<MDL (4.1)	<MDL (1.3)	<MDL (2.0)	53	53
Miscellaneous Compounds						
Dibenzofuran	<MDL (6.8)	<MDL (5.2)	<MDL (1.7)	<MDL (2.6)	15	58
Hexachlorobutadiene	<MDL (0.36)	<MDL (0.28)	<MDL (0.091)	<MDL (0.14)	3.9	6.2
N-Nitrosodiphenylamine	<MDL (9.7)	<MDL (7.5)	<MDL (2.4)	<MDL (3.7)	11	11
PCBs						
Total PCBs	677	369	2.70	3.3	12	65

**Notes**

mg/Kg OC - Milligrams per kilogram organic carbon, based on total organic carbon analysis.

<MDL (#) Analyte not detected above the *method detection limit*. Value in parentheses is the numeric MDL.

TOC % - Percent total organic carbon on a dry weight basis, based on total solids analysis.

Shaded Cell with Double Border - Detected concentration exceeds the SQS and/or CSL.

D - Compound detected in laboratory method blank. Sample concentration is less than 5 times the method blank concentration and should be discounted.

Station NFK503 - TOC &lt; 0.5%, see Table 7 for dry weight-normalized data compared to LAH1/2LAET.

**Table 7**

**Sediment Non-Ionic Organic Concentrations (Dry Weight Normalized)**  
**Norfolk CSO Sediment Remediation Project**  
**Five-Year Monitoring Program**  
**Year Two - April 2001 Monitoring Data**

	Concentration (µg/Kg DW)					
Non-Ionic Organics	NFK501 0 - 2 cm	NFK501 0 - 10 cm	NFK502 0 - 2 cm	NFK502 0 - 10 cm	LAET* SQS	2LAET* CSL
<b>LPAHs</b>						
Acenaphthene	<MDL (10)	<MDL (11)	<MDL (10)	<MDL (11)	500	730
Acenaphthylene	<MDL (22)	<MDL (23)	<MDL (22)	<MDL (23)	1,300	1,300
Anthracene	8.0	11	7.3	7.2	960	4,400
Fluorene	<MDL (19)	<MDL (20)	<MDL (19)	<MDL (20)	540	1,000
2-Methylnaphthalene	<MDL (20)	<MDL (21)	<MDL (21)	<MDL (21)	670	1,400
Naphthalene	<MDL (20)	<MDL (21)	<MDL (21)	<MDL (21)	2,100	2,400
Phenanthrene	65.3	46.8	39.0	31.6	1,500	5,400
Total LPAH	73	58	46	39	5,200	13,000
<b>HPAHs</b>						
Benzo(a)anthracene	60.4	40.8	37.9	38.0	1,300	1,600
Benzo(a)pyrene	92.6	61.4	56.8	24.5	1,600	3,000
Benzofluoranthencs (Total)	198	174	128	118	3,200	3,600
Benzo(g,h,i)perylene	24.8	18	<MDL (12)	<MDL (12)	670	720
Chrysene	81.9	62.1	49.0	42.0	1,400	2,800
Dibenzo(a,h)anthracene	<MDL (10)	<MDL (11)	<MDL (10)	<MDL (11)	730	540
Fluoranthene	162	124	110	100	1,700	2,500
Indeno(1,2,3-c,d)pyrene	33.6	21	22	<MDL (14)	600	690
Pyrene	125	95.7	79.1	50.7	2,600	3,300
Total HPAH	778	600	480	373	12,000	17,000
<b>Chlorobenzenes</b>						
1,2-Dichlorobenzene	<MDL (0.38)	<MDL (0.40)	<MDL (0.39)	<MDL (0.39)	35	50
1,4-Dichlorobenzene	<MDL (0.19)	<MDL (0.20)	<MDL (0.19)	<MDL (0.20)	110	120
Hexachlorobenzene	<MDL (0.96)	<MDL (1.0)	<MDL (0.98)	<MDL (0.99)	22	70
1,2,4-Trichlorobenzene	<MDL (0.38)	<MDL (0.40)	<MDL (0.39)	<MDL (0.39)	31	51
<b>Phthalates</b>						
Bis(2-ethylhexyl) Phthalate	349	246	206	192	1,300	1,900
Butyl Benzyl Phthalate	29.6	57.5	22.1	25.1	63	470
Di-N-butyl Plthalate	46.9, B	43.6, B	32.6, B	30.5, B	1,400	5,100
Di-N-octyl Phthalate	<MDL (12)	<MDL (12)	<MDL (12)	<MDL (12)	420	2,100
Diethyl Phthalate	<MDL (8.8)	<MDL (9.2)	<MDL (8.9)	<MDL (9.0)	48	73
Dimethyl Phthalate	<MDL (16)	<MDL (17)	<MDL (16)	<MDL (17)	71	160
<b>Miscellaneous Compounds</b>						
Dibenzofuran	<MDL (20)	<MDL (21)	<MDL (21)	<MDL (21)	540	700
Hexachlorobutadiene	<MDL (1.1)	<MDL (1.1)	<MDL (1.1)	<MDL (1.1)	11	120
N-Nitrosodiphenylamine	<MDL (29)	<MDL (31)	<MDL (30)	<MDL (30)	28	40
<b>PCBs</b>						
Total PCBs	60.9	35.5	161	94.1	130	1,000

**Notes**

µg/Kg DW - Micrograms per kilogram dry weight, based on percent solids analysis.

<MDL (#) - Analyte not detected above the *method detection limit*. Value in parentheses is the numeric MDL.

Shaded Cell - MDL exceeds the LAET and/or 2LAET.

Shaded Cell with Double Border - Detected concentration exceeds the LAET and/or 2LAET.

B - Compound detected in laboratory method blank. Sample concentration is less than 5 times the method blank concentration and should be discounted.

\* - LAET/2LAET equivalent to SQS/CSL criteria, respectively.

Table 7 (cont.)

**Sediment Non-Ionic Organic Concentrations (Dry Weight Normalized)**  
**Norfolk CSO Sediment Remediation Project**  
**Five-Year Monitoring Program**  
**April 2001 Monitoring Data**

	Concentration (µg/Kg DW)					
Non-Ionic Organics	NFK503 0 - 2 cm	NFK503 0 - 10 cm	NFK504 0 - 2 cm	NFK504 0 - 10 cm	LAET	2LAET
<b>LPAHs</b>						
Acenaphthene	<MDL (9.4)	<MDL (9.4)	<MDL (13)	<MDL (12)	500	730
Acenaphthylene	<MDL (20)	<MDL (20)	<MDL (28)	<MDL (25)	1,300	1,300
Anthracene	<MDL (5.4)	<MDL (5.4)	<MDL (7.6)	<MDL (6.7)	960	4,400
Fluorene	<MDL (17)	<MDL (18)	<MDL (25)	<MDL (22)	540	1,000
2-Methylnaphthalene	<MDL (19)	<MDL (19)	<MDL (27)	<MDL (23)	670	1,400
Naphthalene	< MDL (19)	< MDL (19)	<MDL (27)	<MDL (23)	2,100	2,400
Phenanthrene	8.4	<MDL (5.4)	15.6	10	1,500	5,400
Total LPAH	8.4	<MDL	15.6	10	5,200	13,000
<b>HPAHs</b>						
Benzo(a)anthracene	8.14	3.0	24.9	18.0	1,300	1,600
Benzo(a)pyrene	<MDL (4.0)	<MDL (4.0)	<MDL (5.7)	<MDL (5.0)	1,600	3,000
Benzofluoranthrenes (Total)	16	<MDL (4.0)	33.6	25	3,200	3,600
Benzo(g,h,i)perylene	<MDL (11)	<MDL (11)	<MDL (15)	<MDL (13)	670	720
Chrysene	7.9	<MDL (5.4)	17.2	8.2	1,400	2,800
Dibenzo(a,h)anthracene	<MDL (9.4)	<MDL (9.4)	<MDL (13)	<MDL (12)	230	540
Fluoranthene	24.5	<MDL (11)	50.3	27.5	1,700	2,500
Indeno(1,2,3-c,d)pyrene	<MDL (12)	<MDL (12)	<MDL (17)	<MDL (15)	600	690
Pyrene	5.9	<MDL (5.4)	<MDL (7.6)	<MDL (6.7)	2,600	3,300
Total HPAH	62	3.0	126	79	12,000	17,000
<b>Chlorobenzenes</b>						
1,2-Dichlorobenzene	<MDL (0.35)	<MDL (0.35)	<MDL (0.49)	<MDL (0.43)	35	50
1,4-Dichlorobenzene	<MDL (0.17)	<MDL (0.18)	<MDL (0.25)	<MDL (0.22)	110	120
Hexachlorobenzene	<MDL (0.88)	<MDL (0.89)	(MDL (1.3)	<MDL (1.1)	22	70
1,2,4-Trichlorobenzene	<MDL (0.35)	<MDL (0.35)	<MDL (0.49)	<MDL (0.43)	31	51
<b>Phthalates</b>						
Bis(2-ethylhexyl) Phthalate	51.0, B	42.4, B	389	331	1,300	1,900
Butyl Benzyl Phthalate	<MDL (8.0)	<MDL (8.1)	34.9	28.0	63	470
Di-N-butyl Phthalate	31.6, B	33.9, B	56.2, B	39.3, B	1,400	5,100
Di-N-octyl Phthalate	<MDL (11)	<MDL (11)	<MDL (15)	<MDL (13)	420	2,100
Diethyl Phthalate	<MDL (8.0)	<MDL (8.1)	<MDL (11)	<MDL (10)	48	73
Dimethyl Phthalate	<MDL (15)	<MDL (15)	<MDL (21)	<MDL (18)	71	160
<b>Miscellaneous Compounds</b>						
Dibenzofuran	<MDL (19)	<MDL (19)	<MDL (27)	<MDL (23)	540	700
Hexachlorobutadiene	<MDL (1.0)	<MDL (1.0)	<MDL (1.4)	<MDL (1.2)	11	120
N-Nitrosodiphenylamine	<MDL (27)	<MDL (27)	<MDL (38)	<MDL (33)	28	40
<b>PCBs</b>						
Total PCBs	1,880	1,330	42.2	31	130	1,000

**Notes**

µg/Kg DW - Micrograms per kilogram dry weight, based on percent solids analysis.

<MDL (#) - Analyte not detected above the *method detection limit*. Value in parentheses is the numeric MDL.

Shaded Cell - MDL exceeds the LAET and/or 2LAET.

Shaded Cell with Double Border - Detected concentration exceeds the LAET and/or 2LAET.

B - Compound detected in laboratory method blank. Sample concentration is less than 5 times the method blank concentration and should be discounted.

\* - LAET/2LAET equivalent to SQS/CSL criteria, respectively.

**Table 8**  
**Dry Weight Comparison of Detected Sediment Constituents (0 - 10 cm Depth Stratum)**  
**April 1999, October 1999, April 2000, and April 2001 Monitoring Events**  
**Norfolk CSO Sediment Remediation Project**  
**Five-Year Monitoring Program (Year Two)**

Constituent	Norfolk CSO Channel (NFK501)				Combined Channel Delta (NFK502)				Boeing Storm Drain Channel (NFK503)				Upriver Reference (NFK504)			
	Apr-99	Oct-99	Apr-00	Apr-01	Apr-99	Oct-99	Apr-00	Apr-01	Apr-99	Oct-99	Apr-00	Apr-01	Apr-99	Oct-99	Apr-00	Apr-01
Total Organic Carbon (mg/kg dry weight)	1,760	3,240	2,350	8,670	1,210	3,730	1,440	4,990	3,180	3,070	2,010	3,600	1,760	1,890	3,090	9,080
Grain Size (% wet weight)																
Gravel	0.8	0.1	0.3	1.5	0.4	0.5	1.1	0	0.4	1.1	0.8	1.0	0.4	0.9	0.6	0.5
Sand	98.6	95.6	94.3	78.8	95.5	89.9	92.6	90.7	94.3	92.5	96.1	97.0	96.7	96.4	90.0	65.4
Silt	1.0	3.4	4.5	16.6	4.7	9.3	5.8	6.8	5.4	6.2	3.5	1.5	2.9	1.8	9.1	27.7
Clay	0	0.7	0.1	3.7	0	0.9	0	2.4	0	0.7	0	0.6	3	0.1	0.1	6.6
Metals (mg/kg dry weight)																
Arsenic	<MDL (3.3)	3.5	4.1	<MDL (18)	3.7	3.5	4.6	<MDL (3.6)	<MDL (3.2)	4.3	4.4	<MDL (3.2)	3.5	5.7	6.0	<MDL (0.42)
Cadmium	0.20	<MDL (0.20)	<MDL (0.21)	<MDL (0.21)	0.21	<MDL (0.19)	<MDL (0.20)	<MDL (0.21)	<MDL (0.21)	<MDL (0.21)	<MDL (0.21)	<MDL (0.20)	0.21	<MDL (0.19)	<MDL (0.20)	<MDL (0.25)
Chromium	12.9	17.1	14.1	17.4	13.0	13.9	12.5	13.3	14.7	14.1	12.2	12.0	11.2	16.4	14.0	17.8
Copper	11.4	13.4	12.0	18.5	12.2	13.8	11.2	13.1	10.5	14.5	11.2	12.9	1.2	13.7	15.1	18.8
Lead	4.2	5.2	5.7	7.36	5.0	5.7	5.4	7.83	4.4	5.5	6.5	8.0	4.6	5.5	6.7	13.8
Mercury	0.055	<MDL (0.027)	<MDL (0.026)	0.04	0.089	0.043	<MDL (0.027)	<MDL (0.030)	0.066	0.052	<MDL (0.028)	0.10	0.072	<MDL (0.026)	<MDL (0.027)	0.038
Zinc	46.0	51.3	43.7	59.0	43.2	52.5	46.8	46.5	42.1	53.7	44.5	46.4	44.2	52.9	46.8	60.6
Organics (µg/kg dry weight)																
Anthracene	<MDL (21)	<MDL (21)	<MDL (22)	11	<MDL (21)	<MDL (22)	<MDL (22)	7.2	<MDL (21)	<MDL (22)	<MDL (22)	<MDL (5.4)	<MDL (21)	<MDL (22)	<MDL (21)	<MDL (6.7)
Benzo(a)anthracene	<MDL (35)	<MDL (21)	<MDL (22)	40.8	<MDL (21)	78	<MDL (22)	38.0	<MDL (21)	28	<MDL (22)	3.0	<MDL (21)	<MDL (22)	<MDL (31)	18.0
Benzo(a)pyrene	<MDL (35)	<MDL (36)	<MDL (37)	61.4	<MDL (35)	<MDL (36)	<MDL (37)	24.5	<MDL (35)	<MDL (37)	<MDL (37)	<MDL (4.0)	<MDL (35)	<MDL (37)	<MDL (36)	<MDL (5.0)
Benzoofluoranthenes (total)	<MDL (56)	<MDL (58)	<MDL (59)	174	<MDL (56)	<MDL (60)	<MDL (58)	118	<MDL (56)	<MDL (59)	<MDL (59)	<MDL (4.0)	<MDL (56)	<MDL (58)	<MDL (79)	<MDL (25)
Benzo(g,h,i)perylene	<MDL (135)	<MDL (136)	<MDL (137)	18	<MDL (135)	<MDL (136)	<MDL (137)	<MDL (137)	70.5	<MDL (137)	<MDL (137)	<MDL (11)	<MDL (135)	<MDL (137)	<MDL (16)	<MDL (13)
Benzoic Acid	<MDL (140)	<MDL (150)	210	122	<MDL (140)	<MDL (150)	150	152	<MDL (140)	<MDL (150)	<MDL (150)	67.6	<MDL (140)	<MDL (150)	150	168
Bis(2-ethylhexyl) Phthalate	<MDL (21)	<MDL (360)**	<MDL (360)**	246	<MDL (21)	<MDL (360)**	<MDL (240)**	192	<MDL (21)	<MDL (360)**	<MDL (360)**	<MDL (77)**	<MDL (21)	<MDL (360)**	<MDL (360)**	331
Butyl Benzyl Phthalate	<MDL (21)	<MDL (21)	<MDL (22)	57.5	<MDL (21)	<MDL (22)	<MDL (22)	25.1	<MDL (21)	<MDL (22)	<MDL (22)	<MDL (8.1)	<MDL (21)	<MDL (22)	<MDL (21)	28.0
Chrysene	<MDL (21)	<MDL (21)	<MDL (22)	62.1	<MDL (21)	29	<MDL (22)	42.0	<MDL (21)	43	<MDL (22)	<MDL (5.4)	<MDL (21)	<MDL (22)	35	8.2
Fluoranthene	<MDL (35)	32	26	124	<MDL (35)	56.7	<MDL (37)	100	<MDL (35)	66.9	26	<MDL (11)	<MDL (35)	<MDL (37)	63.6	27.5
Indeno(1,2,3-c,d)pyrene	<MDL (21)	<MDL (36)	<MDL (37)	21	<MDL (35)	<MDL (36)	<MDL (37)	<MDL (14)	<MDL (35)	<MDL (37)	<MDL (37)	<MDL (12)	<MDL (35)	<MDL (37)	<MDL (36)	<MDL (13)
Phenanthrene	21	<MDL (21)	<MDL (22)	46.8	<MDL (21)	29	<MDL (22)	31.6	<MDL (21)	40.3	<MDL (22)	<MDL (5.4)	<MDL (21)	<MDL (22)	<MDL (11)	10
Pyrene	<MDL (21)	29	<MDL (22)	95.7	<MDL (21)	47.9	<MDL (22)	50.7	<MDL (21)	64.6	<MDL (22)	<MDL (5.4)	<MDL (21)	<MDL (22)	<MDL (22)	<MDL (6.7)
Total PCBs	<MDL (22)	20.9	<MDL (6.8)	35.5	<MDL (22)	71.6	10	94.1	<MDL (22)	182	179	1,330	<MDL (22)	<MDL (5.7)	13.2	31

**Notes**

mg/kg dry weight - Milligrams per kilogram normalized to dry weight based on percent solids analysis  
 µg/kg dry weight - Micrograms per kilogram normalized to dry weight based on percent solids analysis.  
 < MDL (#) - Analyte not detected above the method detection limit. Value in parentheses is the number < MDL.  
 \*\* MDL raised to 5 X the concentration of bis(2-ethylhexyl)phthalate detected in the method blank.

Table 9

## Dry Weight Comparison of Detected Sediment Constituents (0 - 2 cm Depth Stratum)

October 1999, April 2000, and April 2001 Monitoring Events

## Norfolk CSO Sediment Remediation Project

## Five-Year Monitoring Program (Year Two)

Constituent	Norfolk CSO Channel (NFKS11)			Combined Channel Delta (NFKS02)			Boeing Storm Drain Channel (NFKS03)			Upriver Reference (NFKS04)		
	Oct-99	Apr-00	Apr-01	Oct-99	Apr-00	Apr-01	Oct-99	Apr-00	Apr-01	Oct-99	Apr-00	Apr-01
Total Organic Carbon (mg/Kg dry weight)	4,170	5,530	8,180	7,030	3,390	6,510	6,490	4,930	2,770	5,310	7,900	15,600
Grain Size (% wet weight)												
Gravel	0.5	0.1	0.2	0.6	0.8	0	1.3	0.5	1.0	1.7	1.0	0.5
Sand	91.0	83.6	81.5	83.6	86.9	89.1	90.8	93.7	95.9	82.3	74.1	80.7
Silt	6.3	14.8	14.5	13.2	7.7	5.9	6.8	5.9	2.6	13.6	23.8	14.4
Clay	1.5	0.9	3.8	3.4	0.1	3.1	1.5	0.1	0.6	3.0	0.9	4.6
Metals (mg/Kg dry weight)												
Arsenic	4.5	5.1	<MDL (3.6)	6.2	5.3	<MDL (3.6)	4.0	5.0	<MDL (3.3)	6.3	7.3	<MDL (4.7)
Chromium	156	17.1	16.1	14.7	15.2	16.7	15.4	13.0	13.2	13.2	22.1	21.1
Copper	155	14.1	17.2	18.6	13.3	15.5	17.1	13.4	11.4	17.1	18.4	24.9
Lead	6.2	6.4	11.6	9.0	7.0	9.39	6.3	6.5	7.36	8.2	8.7	18.0
Mercury	0.039	0.043	0.069	0.042	0.063	0.031	0.029	0.028	<MDL (0.025)	0.028	0.049	0.072
Zinc	52.4	48.4	56.6	62.2	49.4	51.6	52.6	46.0	43.4	55.6	56.1	68.3
Organics (µg/Kg dry weight)												
Anthracene	<MDL (22)	<MDL (21)	8.0	<MDL (25)	<MDL (22)	7.3	<MDL (22)	<MDL (22)	<MDL (5.4)	<MDL (23)	<MDL (24)	<MDL (7.6)
Benzo(a)anthracene	26	37.5	60.4	56.7	<MDL (22)	37.9	48.8	<MDL (22)	8.14	36	66.0	24.9
Benzo(a)pyrene	<MDL (36)	41	92.6	59	<MDL (37)	56.8	53	<MDL (37)	<MDL (4.0)	<MDL (39)	59	<MDL (5.7)
Benzoofluoranthenes (Total)	<MDL (38)	57	198	<MDL (67)	<MDL (39)	128	76	<MDL (39)	16	64	110	33.6
Benzo(g,h,i)perylene	76.2	<MDL (35)	24.8	<MDL (42)	<MDL (37)	<MDL (12)	<MDL (38)	<MDL (37)	<MDL (11)	<MDL (39)	44	<MDL (15)
Benzoic Acid	170	258	299	250	227	162	<MDL (150)	226	809	190	380	268
Bis(2-ethylhexyl) Phthalate	<MDL (80)**	<MDL (240)**	349	<MDL (360)**	<MDL (240)**	206	<MDL (360)**	<MDL (240)**	<MDL (93)**	<MDL (360)**	413	389
Butyl Benzyl Phthalate	<MDL (22)	<MDL (21)	29.6	<MDL (25)	<MDL (22)	22.1	<MDL (22)	<MDL (22)	<MDL (8.0)	<MDL (23)	<MDL (24)	34.9
Chrysene	32	58.2	81.9	84.7	29	49.0	72.4	34	7.9	53.1	94.7	17.2
1,4-Dichlorobenzene	<MDL (0.43)	0.99	<MDL (0.19)	<MDL (1.1)	<MDL (0.94)	<MDL (0.19)	<MDL (0.96)	<MDL (0.95)	<MDL (0.17)	<MDL (1.0)	<MDL (1.1)	<MDL (0.23)
Fluoranthene	602	101	162	132	54.0	110	119	52.2	24.5	75.1	178	50.3
Indeno(1,2,3-c,d)pyrene	<MDL (36)	<MDL (35)	33.6	46	<MDL (37)	22	<MDL (38)	<MDL (37)	<MDL (12)	<MDL (39)	52	<MDL (17)
Phenanthrene	28	44.7	65.3	62.4	25	39.0	80.1	25	8.4	38	76.5	15.6
Pyrene	591	79.0	125	126	37.8	79.1	125	38.4	5.9	75.9	159	<MDL (7.6)
Total PCBs	45.9	6.8	60.9	61.8	70.6	161	306	271	1,880	25	6.6	42.2

## Notes

mg/Kg dry weight - Milligram per kilogram normalized to dry weight based on percent solids analysis.

µg/Kg dry weight - Micrograms per kilogram normalized to dry weight based on percent solids analysis.

&lt; MDL (#) - Analyte not detected above the method detection limit. Value in parentheses is the numeric MDL.

\*\* MDL raised to 5 X the concentration of bis(2-ethylhexyl)phthalate detected in the method blank.

# King County Environmental Lab Analytical Report

PROJECT: 423056-160  
Norfolk CSO Sediment Remediation  
Five-Year Monitoring Program  
Year Two - April 2001 Sampling Event

Locato: NFK501  
Descript: Norfolk CSO Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-1  
Matrix: SALTWTRSED  
% Solids: 68.5

Locator: NFK501  
Descript: Norfolk CSO Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-2  
Matrix: SALTWTRSED  
% Solids: 35.4

Locator: NFK502  
Descript: Combined Channel Delta  
Sampled: Apr 24, 2001  
Lab ID: L20703-3  
Matrix: SALTWTRSED  
% Solids: 67.1

Locator: NFK502  
Descript: Combined Channel Delta  
Sampled: Apr 24, 2001  
Lab ID: L20703-4  
Matrix: SALTWTRSED  
% Solids: 66.5

## Parameters

Value Qual MDL RDL Units  
- Dry Weight Basis

Value Qual MDL RDL Units  
- Dry Weight Basis

Value Qual MDL RDL Units  
- Dry Weight Basis

Value Qual MDL RDL Units  
- Dry Weight Basis

## COMBINED LABS

M-CV ASTM D422

Parameters	Value	Qual	MDL	RDL	Units
Clay *	3.8	E	0.1		%
Gravel *	0.22	E	0.1		%
p+0.00 *	1.8		0.1		%
p+1.00 *	16.3		0.1		%
p+10.0 *	0.96		0.1		%
p+10.0(more than) *	1.3		0.1		%
p+2.00 *	42.6		0.1		%
p+3.00 *	9.2		0.1		%
p+4.00 *	11.6		0.1		%
p+5.00 *	6.1		0.1		%
p+6.00 *	3.8		0.1		%
p+7.00 *	2.4		0.1		%
p+8.00 *	2.2		0.1		%
p+9.00 *	1.5		0.1		%
p+1.00 *	0.22		0.1		%
p+2.00 *	<MDL		0.1		%
p+2.00(less than) *	<MDL		0.1		%
Sand *	81.4		0.1		%
Silt *	14.6		0.1		%

M-CV EPA 8080-PSEP96 (0304-002-001)

Total Organic Carbon

M-CV SM2540-G (03-01-007-001)

Total Solids \*

M-ES NONE

Sampcoortx1 \*

Sampcoortx2 \*

Sampcoortx3 \*

Sampcoortx1 \*

Sampcoortx2 \*

Sampcoortx3 \*

Sample Depth \*

Sample Start Time \*

Sampling Method

Sediment Sampling Depth \*

Sediment Sampling Range \*

Sediment Type

Tidal Condition

12/20/01 - 5 year monitoring 0401 comp report

Data Management and Analysis Section Comprehensive Report #10136

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King County Environmental Lab Analytical Report

PROJECT: 423056-160

Norfolk CSO Sediment Remediation  
Five-Year Monitoring Program  
Year Two - April 2011 Sampling Event

Locator: NFK501  
Describe: Norfolk CSO Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-1  
Matrix: SALTWTRSED  
% Solids: 68.5

Parameters

COMBINED LABS

Tide Height \*

2

ft

Value Qual MDL RDL Units  
- Dry Weight Basis

2

ft

Locator: NFK501  
Describe: Norfolk CSO Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-2  
Matrix: SALTWTRSED  
% Solids: 65.4

Value Qual MDL RDL Units  
- Dry Weight Basis

0

ft

Locator: NFK502  
Describe: Combined Channel Delta  
Sampled: Apr 24, 2001  
Lab ID: L20703-3  
Matrix: SALTWTRSED  
% Solids: 67.1

Value Qual MDL RDL Units  
- Dry Weight Basis

0

ft

Locator: NFK502  
Describe: Combined Channel Delta  
Sampled: Apr 24, 2001  
Lab ID: L20703-4  
Matrix: SALTWTRSED  
% Solids: 66.5

Value Qual MDL RDL Units  
- Dry Weight Basis

0

ft

# King County Environmental Lab Analytical Report

PROJECT: 423056-160	Location: NFK501	Location: NFK502	Location: NFK502
Norfolk CSO Sediment Remediation	Describe: Norfolk CSO Channel	Describe: Combined Channel Delta	Describe: Combined Channel Delta
Five-Year Monitoring Program	Sampled: Apr 24, 2001	Sampled: Apr 24, 2001	Sampled: Apr 24, 2001
Year Two - April 2001 Sampling Event	Lab ID: L20703-1	Lab ID: L20703-2	Lab ID: L20703-3
	Matrix: SALTWTRSED	Matrix: SALTWTRSED	Matrix: SALTWTRSED
	% Solids: 66.5	% Solids: 65.4	% Solids: 67.1

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
- Dry Weight Basis															
<b>COMBINED LABS</b>															
M-MT EPA 245.5 (06-01-304-003)	0.069	<RDL	0.026	0.283	mg/Kg	0.043	<RDL	0.031	0.3	mg/Kg	0.031	<RDL	0.03	0.295	mg/Kg
M-MT EPA 3050A/0108 (06-02-004-002)															
Aluminum, Total, ICP	11900	L	7.4	37.2	mg/Kg	13300	L	7.6	38.1	mg/Kg	10900	L	7.2	35.9	mg/Kg
Arsenic Total, ICP		<MDL	3.6	18.5	mg/Kg		<MDL	3.8	19.1	mg/Kg		<MDL	3.6	17.9	mg/Kg
Beryllium, Total, ICP	0.34	<RDL	0.074	0.372	mg/Kg	0.382		0.076	0.381	mg/Kg	0.27	<RDL	0.072	0.359	mg/Kg
Cadmium, Total, ICP		<MDL	0.22	1.12	mg/Kg		<MDL	0.23	1.14	mg/Kg		<MDL	0.21	1.08	mg/Kg
Chromium, Total, ICP	16.1		0.36	1.85	mg/Kg	17.4		0.38	1.91	mg/Kg	16.7		0.36	1.79	mg/Kg
Copper Total, ICP	17.2		0.26	1.49	mg/Kg	18.5		0.31	1.52	mg/Kg	15.5		0.28	1.44	mg/Kg
Iron, Total, ICP	20700	G	3.6	18.5	mg/Kg	22300	G	3.8	19.1	mg/Kg	19800	G	3.6	17.9	mg/Kg
Lead, Total, ICP	11.6		2.2	11.2	mg/Kg	11.8		2.3	11.4	mg/Kg	9.4	<RDL	2.1	10.8	mg/Kg
Manganese, Total, ICP	629		0.16	0.743	mg/Kg	492		0.15	0.763	mg/Kg	402		0.14	0.717	mg/Kg
Nickel, Total, ICP	14.6		1.5	7.43	mg/Kg	15.2		1.5	7.83	mg/Kg	12.6		1.4	7.17	mg/Kg
Selenium, Total, ICP		<MDL	3.6	18.5	mg/Kg		<MDL	3.8	19.1	mg/Kg		<MDL	3.6	17.9	mg/Kg
Silver, Total, ICP		<MDL	0.28	1.49	mg/Kg		<MDL	0.31	1.52	mg/Kg		<MDL	0.28	1.44	mg/Kg
Thallium, Total, ICP		<MDL	15	74.3	mg/Kg		<MDL	15	76.3	mg/Kg		<MDL	14	71.7	mg/Kg
Zinc, Total, ICP	56.6		0.36	1.85	mg/Kg	59		0.38	1.91	mg/Kg	51.6		0.36	1.79	mg/Kg
M-OR EPA 3550B/0802 (7-3-03-002)															
Aroclor 1016		<MDL	6.1	12.2	ug/Kg		<MDL	6.4	12.7	ug/Kg		<MDL	6.3	12.4	ug/Kg
Aroclor 1221		<MDL	6.1	12.2	ug/Kg		<MDL	6.4	12.7	ug/Kg		<MDL	6.3	12.4	ug/Kg
Aroclor 1232		<MDL	6.1	12.2	ug/Kg		<MDL	6.4	12.7	ug/Kg		<MDL	6.3	12.4	ug/Kg
Aroclor 1242		<MDL	6.1	12.2	ug/Kg		<MDL	6.4	12.7	ug/Kg		<MDL	6.3	12.4	ug/Kg
Aroclor 1248	30.4		6.1	12.2	ug/Kg	16.8		6.4	12.7	ug/Kg	93		6.3	12.4	ug/Kg
Aroclor 1254	30.5		6.1	12.2	ug/Kg	16.7		6.4	12.7	ug/Kg	68.4		6.3	12.4	ug/Kg
Aroclor 1260		<MDL	6.1	12.2	ug/Kg		<MDL	6.4	12.7	ug/Kg		<MDL	6.3	12.4	ug/Kg
M-OR EPA 3550B/0820C (7-3-01-004)															
1,2,4-Trichlorobenzene		<MDL,G	0.38	0.774	ug/Kg		<MDL,G	0.4	0.81	ug/Kg		<MDL,G	0.39	0.79	ug/Kg
1,2-Dichlorobenzene		<MDL,G	0.38	0.774	ug/Kg		<MDL,G	0.4	0.81	ug/Kg		<MDL,G	0.39	0.79	ug/Kg
1,2-Diphenylhydrazine		<MDL	15	29.2	ug/Kg		<MDL	15	30.6	ug/Kg		<MDL	15	29.8	ug/Kg
1,3-Dichlorobenzene		<MDL,G	0.38	0.774	ug/Kg		<MDL,G	0.4	0.81	ug/Kg		<MDL,G	0.39	0.79	ug/Kg
1,4-Dichlorobenzene		<MDL,G	0.19	0.385	ug/Kg		<MDL,G	0.2	0.404	ug/Kg		<MDL,G	0.19	0.393	ug/Kg
2,4,5-Trichlorophenol		<MDL	18	35	ug/Kg		<MDL,G	18	36.7	ug/Kg		<MDL,G	18	35.8	ug/Kg
2,4,6-Trichlorophenol		<MDL	19	38	ug/Kg		<MDL,G	20	39.8	ug/Kg		<MDL,G	19	38.7	ug/Kg
2,4-Dichlorophenol		<MDL	23	46.7	ug/Kg		<MDL,G	24	48.9	ug/Kg		<MDL,G	24	47.7	ug/Kg
2,4-Dimethylphenol		<MDL	10	20.4	ug/Kg		<MDL,G	11	21.4	ug/Kg		<MDL,G	10	20.9	ug/Kg
2,4-Dinitrotoluene		<MDL	4.4	8.76	ug/Kg		<MDL	4.6	9.17	ug/Kg		<MDL	4.5	8.94	ug/Kg
2,6-Dinitrotoluene		<MDL	15	29.2	ug/Kg		<MDL	15	30.6	ug/Kg		<MDL	15	29.8	ug/Kg
2-Chloronaphthalene		<MDL	23	46.7	ug/Kg		<MDL	24	48.9	ug/Kg		<MDL	24	47.7	ug/Kg

# King County Environmental Lab Analytical Report

**PROJECT: 423056-160**  
**Norfolk CSO Sediment Remediation**  
**Five-Year Monitoring Program**  
**Year Two - April 2001 Sampling Event**

Locator:	NFK501
Descrip:	Norfolk CSO Channel
Sampled:	Apr 24, 2001
Lab ID:	L20703-1
Matrix:	SALTWTRSED
% Solids:	68.5

Locator:	NFK501
Describe:	Norfolk CSO Channel
Sampled:	Apr 24, 2001
Lab ID:	L20703-2
Matrix:	SALTWTRSED
% Solids:	65.4

Locator:	NFK502
Descrip:	Combined Channel Delta
Sampled:	Apr 24, 2001
Lab ID:	L20703-3
Matrix:	SALTWTRSED
% Solids:	67.1

**Locator:** NFK502  
**Describe:** Combined Channel Delta  
**Sampled:** Apr 24, 2001  
**Lab ID:** L20705-4  
**Matrix:** SALTYWTRSED  
 g / Solid: 66.5

Parameters	- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis				
	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
COMBINED LABS															
2-Chlorophenol		<MDL,G	12	23.4 ug/Kg			<MDL,G	12	24.5 ug/Kg			<MDL,G	12	23.8 ug/Kg	
2-Methylnaphthalene		<MDL	20	40.9 ug/Kg			<MDL	21	42.8 ug/Kg			<MDL	21	41.7 ug/Kg	
2-Methylphenol		<MDL	28	55.5 ug/Kg			<MDL,G	29	58.1 ug/Kg			<MDL,G	28	56.6 ug/Kg	
2-Nitrophenol		<MDL	22	43.8 ug/Kg			<MDL,G	23	45.9 ug/Kg			<MDL,G	22	44.7 ug/Kg	
4-Bromophenyl Phenyl Ether		<MDL	13	26.3 ug/Kg			<MDL	14	27.5 ug/Kg			<MDL	13	26.8 ug/Kg	
4-Chlorophenyl Phenyl Ether		<MDL	19	38 ug/Kg			<MDL	20	39.8 ug/Kg			<MDL	19	38.7 ug/Kg	
4-Methylphenol		<MDL	23	46.7 ug/Kg			<MDL,G	24	48.9 ug/Kg			<MDL,G	24	47.7 ug/Kg	
Acenaphthene		<MDL	10	20.4 ug/Kg			<MDL	11	21.4 ug/Kg			<MDL	10	20.9 ug/Kg	
Acenaphthylene		<MDL	22	43.8 ug/Kg			<MDL	23	45.9 ug/Kg			<MDL	22	44.7 ug/Kg	
Aniline		<MDL,X	28	55.5 ug/Kg			<MDL,X	29	58.1 ug/Kg			<MDL,X	28	56.6 ug/Kg	
Anthracene	8	<RDL	5.8	11.7 ug/Kg			11	<RDL	6.1	12.2 ug/Kg			7.3	<RDL	6
Benzo(e)anthracene	60.4		2.9	5.84 ug/Kg			40.8		3.1	6.12 ug/Kg			37.9		3
Benzo(e)pyrene	92.6	E	4.4	8.76 ug/Kg			61.5	E	4.6	9.17 ug/Kg			56.8	E	4.5
Benzo(f)fluoranthene	142	E	4.4	8.76 ug/Kg			97.9	E	4.6	9.17 ug/Kg			93.6	E	4.5
Benzo(g,h,i)perylene	24.8	G	12	23.4 ug/Kg			18	<RDL,G	12	24.5 ug/Kg			<MDL,G	12	23.8 ug/Kg
Benzo(k)fluoranthene	56.2		4.4	8.76 ug/Kg			40.2		4.6	9.17 ug/Kg			34.1		4.5
Benzoic Acid	299		8.8	17.5 ug/Kg			122	G	9.2	18.3 ug/Kg			162	G	8.3
Benzyl Alcohol		<MDL	8.8	17.5 ug/Kg			<MDL	9.2	18.3 ug/Kg			<MDL	8.3	17.9 ug/Kg	
Benzyl Butyl Phthalate	29.6		8.8	17.5 ug/Kg			57.5		9.2	18.3 ug/Kg			22.1		8.3
Bis(2-Chloroethoxy)Methane		<MDL	25	49.6 ug/Kg			<MDL	26	52 ug/Kg			<MDL	25	50.7 ug/Kg	
Bis(2-Chloroethyl)Ether		<MDL,G	22	43.8 ug/Kg			<MDL,G	23	45.9 ug/Kg			<MDL,G	22	44.7 ug/Kg	
Bis(2-Chloroisopropyl)Ether		<MDL	22	43.8 ug/Kg			<MDL	23	45.9 ug/Kg			<MDL	22	44.7 ug/Kg	
Bis(2-Ethylhexyl)Phthalate	349	B,L	9.8	20.4 ug/Kg			246	B,L	10	21.4 ug/Kg			206	B,L	10
Caffeine		<MDL,L	8.8	17.5 ug/Kg			<MDL,L	9.2	18.3 ug/Kg			<MDL,L	8.9	17.9 ug/Kg	
Carbazole	16	<RDL	10	20.4 ug/Kg			12	<RDL	11	21.4 ug/Kg			<MDL	10	20.9 ug/Kg
Chrysene	81.9	E	5.8	11.7 ug/Kg			62.1	E	6.1	12.2 ug/Kg			49	E	6
Coprostanol		<MDL	20	40.9 ug/Kg			<MDL	21	42.8 ug/Kg			<MDL	21	41.7 ug/Kg	
Dibenz(a,h)anthracene		<MDL	20	40.9 ug/Kg			<MDL	11	21.4 ug/Kg			<MDL	10	20.9 ug/Kg	
Dibenzofuran		<MDL	20	40.9 ug/Kg			<MDL	21	42.8 ug/Kg			<MDL	21	41.7 ug/Kg	
Diethyl Phthalate		<MDL	8.8	17.5 ug/Kg			<MDL	9.2	18.3 ug/Kg			<MDL	8.9	17.9 ug/Kg	
Dimethyl Phthalate		<MDL	16	32.1 ug/Kg			<MDL	17	33.6 ug/Kg			<MDL	16	32.8 ug/Kg	
Di-N-Butyl Phthalate	46.9	B	7.3	14.6 ug/Kg			436	B	7.6	15.3 ug/Kg			32.6	B	

# King County Environmental Lab Analytical Report

PROJECT: 423056-160  
Norfolk CSO Sediment Remediation  
Five-Year Monitoring Program  
Year Two - April 2001 Sampling Event

Locator: NFK501  
Descrip: Norfolk CSO Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-1  
Matrix: SALTWTRSED  
% Solids: 68.5

Locator: NFK501  
Descrip: Norfolk CSO Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-2  
Matrix: SALTWTRSED  
% Solids: 65.4

Locator: NFK502  
Descrip: Combined Channel Delta  
Sampled: Apr 24, 2001  
Lab ID: L20703-3  
Matrix: SALTWTRSED  
% Solids: 67.1

Locator: NFK502  
Descrip: Combined Channel Delta  
Sampled: Apr 24, 2001  
Lab ID: L20703-4  
Matrix: SALTWTRSED  
% Solids: 66.5

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
COMBINED LABS															
Indeno(1,2,3-cd)Pyrene	33.6	<MDL	13	26.3	ug/Kg	21	<RDL	14	27.5	ug/Kg	22	<RDL	13	26.8	ug/Kg
Isophorone		<MDL	28	55.5	ug/Kg		<MDL	29	58.1	ug/Kg		<MDL	28	56.8	ug/Kg
Naphthalene		<MDL	20	40.9	ug/Kg		<MDL	21	42.8	ug/Kg		<MDL	21	41.7	ug/Kg
Nitrobenzene		<MDL	23	46.7	ug/Kg		<MDL	24	48.9	ug/Kg		<MDL	24	47.7	ug/Kg
N-Nitrosodimethylamine		<MDL	29	58.4	ug/Kg		<MDL	31	61.2	ug/Kg		<MDL	30	59.6	ug/Kg
N-Nitrosodi-N-Propylamine		<MDL	13	26.3	ug/Kg		<MDL	14	27.5	ug/Kg		<MDL	13	26.8	ug/Kg
N-Nitrosodiphenylamine		<MDL	29	58.4	ug/Kg		<MDL	31	61.2	ug/Kg		<MDL	30	59.6	ug/Kg
Pentachlorophenol		<MDL	7.3	14.6	ug/Kg		<MDL	7.6	15.3	ug/Kg		<MDL	7.5	14.9	ug/Kg
Phenanthrene	65.3	E	5.8	11.7	ug/Kg	43.8	E	6.1	12.2	ug/Kg	39	E	6	11.9	ug/Kg
Phenol		<MDL	13	26.3	ug/Kg		<MDL	14	27.5	ug/Kg		<MDL	13	26.8	ug/Kg
Pyrene	125	E	5.8	11.7	ug/Kg	95.7	E	6.1	12.2	ug/Kg	79.1	E	6	11.9	ug/Kg
* Not converted to dry weight basis for this parameter															

King County Environmental Lab Analytical Report

PROJECT: 423056-160

Norfolk CSO Sediment Remediation  
Five-Year Monitoring Program  
Year Two - April 2001 Sampling Event

Locator: NFK503  
Descript: Boeing Storm Drain Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-5  
Matrix: SALTWTRSED  
% Solids: 74.7

Locator: NFK503  
Descript: Boeing Storm Drain Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-6  
Matrix: SALTWTRSED  
% Solids: 74.1

Locator: NFK504  
Descript: Upriver Reference  
Sampled: Apr 24, 2001  
Lab ID: L20703-7  
Matrix: SALTWTRSED  
% Solids: 52.7

Locator: NFK504  
Descript: Upriver Reference  
Sampled: Apr 24, 2001  
Lab ID: L20703-8  
Matrix: SALTWTRSED  
% Solids: 60.1

Parameters

COMBINED LABS

M-CV ASTM D422

Parameters	Value	Qual	MDL	RDL	Units
Clay *	0.65		0.1	%	%
Gravel *	0.98	E	0.1	%	%
p+0.00 *	4.9		0.1	%	%
p+1.00 *	28.6		0.1	%	%
p+10.0 *	0.14		0.1	%	%
p+10.0(more than) *	0.41		0.1	%	%
p+2.00 *	55.7		0.1	%	%
p+3.00 *	5.9		0.1	%	%
p+4.00 *	0.75		0.1	%	%
p+5.00 *	1.8		0.1	%	%
p+6.00 *	0.27		0.1	%	%
p+7.00 *	0.25		0.1	%	%
p+8.00 *	0.2		0.1	%	%
p+9.00 *	0.1		0.1	%	%
p-1.00 *	0.98		0.1	%	%
p-2.00 *	<MDL		0.1	%	%
p-2.00(less than) *	<MDL		0.1	%	%
Sand *	95.8		0.1	%	%
Silt *	2.5		0.1	%	%

M-CV EPA9000-PSEP96 03-04-002-001)

Total Organic Carbon

M-CV SM2540-G (03-01-007-001)

Total Solids *	2770		670	1340	mg/Kg
	74.7		0.005	0.01	%

M-ES NONE

Sampccordx1 *	1278555			ft	
Sampccordx2 *	1278547			ft	
Sampccordx3 *	1278545			ft	
Sampccordy1 *	190175			ft	
Sampccordy2 *	190181			ft	
Sampccordy3 *	190176			ft	
Sample Depth *	1			m	
Sample Start Time *	1116			hr	

Sampling Method	26816.6			none	
Sediment Sampling Depth *	11			cm	
Sediment Sampling Range *	0-2 cm			none	
Sediment Type	30N20			none	
Tidal Condition	E			none	

Value Qual MDL RDL Units  
- Dry Weight Basis

	4.5		0.1	%	%
	0.46	E	0.1	%	%
	2.1		0.1	%	%
	21.7		0.1	%	%
	0.85		0.1	%	%
	2.1		0.1	%	%
	43.3		0.1	%	%
	6.8		0.1	%	%
	6.1		0.1	%	%
	4.2		0.1	%	%
	4.8		0.1	%	%
	3.1		0.1	%	%
	2.3		0.1	%	%
	1.6		0.1	%	%
	0.46		0.1	%	%
	<MDL		0.1	%	%
	<MDL		0.1	%	%
	80.6		0.1	%	%
	14.4		0.1	%	%
	15600		950	1900	mg/Kg

Value Qual MDL RDL Units  
- Dry Weight Basis

	0.6		0.1	%	%
	1	E	0.1	%	%
	4.1		0.1	%	%
	32.1		0.1	%	%
	<MDL		0.1	%	%
	0.36		0.1	%	%
	55		0.1	%	%
	5.2		0.1	%	%
	0.57		0.1	%	%
	1		0.1	%	%
	0.8		0.1	%	%
	0.6		0.1	%	%
	0.2		0.1	%	%
	0.5		0.1	%	%
	1		0.1	%	%
	<MDL		0.1	%	%
	<MDL		0.1	%	%
	969		0.1	%	%
	15		0.1	%	%
	3610		670	1350	mg/Kg

Value Qual MDL RDL Units  
- Dry Weight Basis

	1278628			ft	
	1278624			ft	
	1278622			ft	
	190072			ft	
	190077			ft	
	190077			ft	
	2			m	
	1210			hr	
	38011.385			none	
	16			cm	
	0-2 cm			none	
	23W21			none	
	33W21			none	
	33331.115			cm	
	1210			hr	
	2			m	

Value Qual MDL RDL Units  
- Dry Weight Basis

	6.5		0.1	%	%
	0.31	E	0.1	%	%
	2.1		0.1	%	%
	15.4		0.1	%	%
	1.1		0.1	%	%
	3.3		0.1	%	%
	30.4		0.1	%	%
	6.5		0.1	%	%
	11		0.1	%	%
	14.2		0.1	%	%
	6.3		0.1	%	%
	4.2		0.1	%	%
	3		0.1	%	%
	2.2		0.1	%	%
	0.31		0.1	%	%
	0.17		0.1	%	%
	<MDL		0.1	%	%
	65.4		0.1	%	%
	27.8		0.1	%	%
	9080		830	1660	mg/Kg

# King County Environmental Lab Analytical Report

PROJECT: 423056-160

Norfolk CSO Sediment Remediation  
Five-Year Monitoring Program  
Year Two - April 2001 Sampling Event

Locator: NFK503

Describe: Boeing Storm Drain Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-5  
Matrix: SALTWTRSED  
% Solids: 74.7

Locator: NFK503

Describe: Boeing Storm Drain Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-6  
Matrix: SALTWTRSED  
% Solids: 74.1

Locator: NFK504

Describe: Upriver Reference  
Sampled: Apr 24, 2001  
Lab ID: L20703-7  
Matrix: SALTWTRSED  
% Solids: 52.7

Locator: NFK504

Describe: Upriver Reference  
Sampled: Apr 24, 2001  
Lab ID: L20703-8  
Matrix: SALTWTRSED  
% Solids: 60.1

Parameters

COMBINED LABS

Tide Height \*

1

ft

Value Qual MDL RDL Units  
- Dry Weight Basis

Value Qual MDL RDL Units  
- Dry Weight Basis

Value Qual MDL RDL Units  
- Dry Weight Basis

Value Qual MDL RDL Units  
- Dry Weight Basis

-0.3

ft

-0.3

ft

# King County Environmental Lab Analytical Report

PROJECT: 423056-160

Norfolk CSO Sediment Remediation  
Five Year Monitoring Program  
Year Two - April 2001 Sampling Event

Locator: NFK503

Describe: Boeing Storm Drain Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-5  
Matrix: SALTWTRSED  
% Solids: 74.7

Locator: NFK503

Describe: Boeing Storm Drain Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-6  
Matrix: SALTWTRSED  
% Solids: 74.1

Locator: NFK504

Describe: Upriver Reference  
Sampled: Apr 24, 2001  
Lab ID: L20703-7  
Matrix: SALTWTRSED  
% Solids: 52.7

Locator: NFK504

Describe: Upriver Reference  
Sampled: Apr 24, 2001  
Lab ID: L20703-8  
Matrix: SALTWTRSED  
% Solids: 60.1

## Parameters

Value Qual MDL RDL Units  
- Dry Weight Basis

Value Qual MDL RDL Units  
- Dry Weight Basis

Value Qual MDL RDL Units  
- Dry Weight Basis

Value Qual MDL RDL Units  
- Dry Weight Basis

## COMBINED LABS

M=MT EPA 245.5 (06-01-004-003)

Mercury Total, CVAA

M=MT EPA 3050A/6010B (06-02-004-002)

Aluminum, Total, ICP

Arsenic, Total, ICP

Beryllium, Total, ICP

Cadmium, Total, ICP

Chromium, Total, ICP

Copper, Total, ICP

Iron, Total, ICP

Lead, Total, ICP

Manganese, Total, ICP

Nickel, Total, ICP

Selenium, Total, ICP

Silver, Total, ICP

Thallium, Total, ICP

Zinc, Total, ICP

M=OR EPA 3550B/8082 (1-3-03-002)

Aroclor 1016

Aroclor 1221

Aroclor 1232

Aroclor 1242

Aroclor 1248

Aroclor 1254

Aroclor 1260

M=OR EPA 3550B/8270C (7-3-01-004)

1,2,4-Trichlorobenzene

1,2-Dichlorobenzene

1,2-Diphenylhydrazine

1,3-Dichlorobenzene

1,4-Dichlorobenzene

2,4,5-Trichlorophenol

2,4,6-Trichlorophenol

2,4-Dichlorophenol

2,4-Dimethylphenol

2,4-Dinitrotoluene

2,6-Dinitrotoluene

2-Chloronaphthalene

# King County Environmental Lab Analytical Report

PROJECT: 423056-160  
Norfolk CSO Sediment Remediation  
Five-Year Monitoring Program  
Year Two - April 2001 Sampling Event

Locator: NFK503  
Descript: Boeing Storm Drain Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-5  
Matrix: SALTWTRSED  
% Solids: 74.7

Locator: NFK503  
Descript: Boeing Storm Drain Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-3  
Matrix: SALTWTRSED  
% Solids: 74.1

Locator: NFK504  
Descript: Upriver Reference  
Sampled: Apr 24, 2001  
Lab ID: L20703-7  
Matrix: SALTWTRSED  
% Solids: 52.7

Locator: NFK504  
Descript: Upriver Reference  
Sampled: Apr 24, 2001  
Lab ID: L20703-8  
Matrix: SALTWTRSED  
% Solids: 60.1

Parameters	- Dry Weigh Basis					- Dry Weight Basis					- Dry Weight Basis										
	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	
COMBINED LABS																					
2-Chlorophenol		<MDL	G	11	21.4 ug/Kg		<MDL	G	11	21.6 ug/Kg		<MDL	G	15	30.4 ug/Kg		<MDL	G	13	26.3 ug/Kg	
2-Methylnaphthalene		<MDL		19	37.5 ug/Kg		<MDL	G	19	37.8 ug/Kg		<MDL	G	27	53.1 ug/Kg		<MDL	G	23	46.3 ug/Kg	
2-Methylphenol		<MDL	G	25	50.9 ug/Kg		<MDL	G	26	51.3 ug/Kg		<MDL	G	36	72.1 ug/Kg		<MDL	G	32	63.2 ug/Kg	
2-Nitrophenol		<MDL	G	20	40.2 ug/Kg		<MDL	G	20	40.5 ug/Kg		<MDL	G	28	56.9 ug/Kg		<MDL	G	25	49.3 ug/Kg	
4-Bromophenyl Phenyl Ether		<MDL		12	24.1 ug/Kg		<MDL	G	12	24.3 ug/Kg		<MDL	G	17	34.2 ug/Kg		<MDL	G	15	30 ug/Kg	
4-Chlorophenyl Phenyl Ether		<MDL		17	34.8 ug/Kg		<MDL	G	18	35.1 ug/Kg		<MDL	G	25	49.3 ug/Kg		<MDL	G	22	43.3 ug/Kg	
4-Methylphenol		<MDL	G	21	42.8 ug/Kg		<MDL	G	22	43.2 ug/Kg		<MDL	G	30	60.7 ug/Kg		<MDL	G	27	53.2 ug/Kg	
Acenaphthene		<MDL		9.4	18.7 ug/Kg		<MDL	G	9.4	18.9 ug/Kg		<MDL	G	13	26.6 ug/Kg		<MDL	G	12	23.3 ug/Kg	
Acenaphthylene		<MDL		20	40.2 ug/Kg		<MDL	G	20	40.5 ug/Kg		<MDL	G	28	56.9 ug/Kg		<MDL	G	25	49.3 ug/Kg	
Aniline		<MDL	X	25	50.9 ug/Kg		<MDL	X	26	51.3 ug/Kg		<MDL	G,X	36	72.1 ug/Kg		<MDL	G,X	32	63.2 ug/Kg	
Anthracene		<MDL		5.4	10.7 ug/Kg		<MDL	G	5.4	10.8 ug/Kg		<MDL	G	7.6	15.2 ug/Kg		<MDL	G	6.7	13.3 ug/Kg	
Benzofluoranthene	8.14			2.7	5.35 ug/Kg	3	<RDL	G	2.7	5.4 ug/Kg		24.9	G	3.8	7.59 ug/Kg	18	G	3.3	6.65 ug/Kg		
Benzofluoranthene		<MDL	E	4	8.03 ug/Kg		<MDL	G,E	4	8.1 ug/Kg			<MDL	G,E	5.7	11.4 ug/Kg		<MDL	G,E	5	9.93 ug/Kg
Benzofluoranthene	10.6	E		4	8.03 ug/Kg		<MDL	G,E	4	8.1 ug/Kg		21.1	G,E	5.7	11.4 ug/Kg	16	G,E	5	9.93 ug/Kg		
Benzofluoranthene		<MDL	G	11	21.4 ug/Kg		<MDL	G	11	21.6 ug/Kg			<MDL	G	15	30.4 ug/Kg		<MDL	G	13	26.3 ug/Kg
Benzofluoranthene	5.8	<RDL		4	8.03 ug/Kg		<MDL	G	4	8.1 ug/Kg		12.5	G	5.7	11.4 ug/Kg	8.5	<RDL	G	5	9.93 ug/Kg	
Benzofluoranthene	80.9	G		3	16.1 ug/Kg	67.6	G		8.1	16.2 ug/Kg		288	G	11	22.8 ug/Kg	168	G	10	20 ug/Kg		
Benzyl Alcohol		<MDL		3	16.1 ug/Kg		<MDL	G	8.1	16.2 ug/Kg			<MDL	G	11	22.8 ug/Kg		<MDL	G	10	20 ug/Kg
Benzyl Butyl Phthalate		<MDL		3	16.1 ug/Kg		<MDL	G	8.1	16.2 ug/Kg		34.9	G	11	22.8 ug/Kg	28	G	10	20 ug/Kg		
Bis(2-Chloroethoxy)Methane		<MDL		23	45.5 ug/Kg		<MDL	G	23	45.9 ug/Kg			<MDL	G	32	64.5 ug/Kg		<MDL	G	28	56.8 ug/Kg
Bis(2-Chloroethoxy)Ether		<MDL	G	20	40.2 ug/Kg		<MDL	G	20	40.5 ug/Kg			<MDL	G	28	56.9 ug/Kg		<MDL	G	25	49.3 ug/Kg
Bis(2-Chloroisopropyl)Ether		<MDL		20	40.2 ug/Kg		<MDL	G	20	40.5 ug/Kg			<MDL	G	28	56.9 ug/Kg		<MDL	G	25	49.3 ug/Kg
Bis(2-Ethylhexyl)Phthalate	51	B,L		9	18.7 ug/Kg	42.4	G,B,L		9	18.9 ug/Kg		389	G,B,L	13	26.6 ug/Kg	331	G,B,L	11	23.3 ug/Kg		
Caffeine		<MDL	L	8	16.1 ug/Kg		<MDL	G,L	8.1	16.2 ug/Kg			<MDL	G,L	11	22.8 ug/Kg		<MDL	G,L	10	20 ug/Kg
Carbazole		<MDL		9.4	18.7 ug/Kg		<MDL	G	9.4	18.9 ug/Kg			<MDL	G	13	26.6 ug/Kg		<MDL	G	12	23.3 ug/Kg
Chrysene	7.9	<RDL	E	5.4	10.7 ug/Kg		<MDL	G,E	5.4	10.8 ug/Kg		17.2	G,E	7.6	15.2 ug/Kg	8.2	<RDL	G,E	6.7	13.3 ug/Kg	
Coprostanol		<MDL		19	37.5 ug/Kg		<MDL	G	19	37.8 ug/Kg			<MDL	G	27	53.1 ug/Kg		<MDL	G	23	46.6 ug/Kg
Dibenzo(a,h)anthracene		<MDL		9.4	18.7 ug/Kg		<MDL	G	9.4	18.9 ug/Kg			<MDL	G	13	26.6 ug/Kg		<MDL	G	12	23.3 ug/Kg
Dibenzofuran		<MDL		19	37.5 ug/Kg		<MDL	G	19	37.8 ug/Kg			<MDL	G	27	53.1 ug/Kg		<MDL	G	23	46.6 ug/Kg
Diethyl Phthalate		<MDL		8	16.1 ug/Kg		<MDL	G	8.1	16.2 ug/Kg			<MDL	G	11	22.8 ug/Kg		<MDL	G	10	20 ug/Kg
Dimethyl Phthalate		<MDL		15	29.5 ug/Kg		<MDL	G	15	29.7 ug/Kg			<MDL	G	21	41.7 ug/Kg		<MDL	G	18	36.6 ug/Kg
Di-N-Ethyl Phthalate	31.6	B		6.7	13.4 ug/Kg	33.9	G,E		6.7	13.5 ug/Kg		56.2	G,B	9.5	19 ug/Kg	39.3	G,B	8.3	16.6 ug/Kg		
Di-N-Octyl Phthalate		<MDL		11	21.4 ug/Kg		<MDL	G	11	21.6 ug/Kg			<MDL	G	15	30.4 ug/Kg		<MDL	G	13	26.6 ug/Kg
Fluoranthene	24.5	L,E		11	21.4 ug/Kg		<MDL	G,L,E	11	21.6 ug/Kg		50.3	G,L,E	15	30.4 ug/Kg	27.5	G,L,E	13	26.6 ug/Kg		
Fluorene		<MDL		17	34.8 ug/Kg		<MDL	G	18	35.1 ug/Kg			<MDL	G	25	49.3 ug/Kg		<MDL	G	22	43.3 ug/Kg
Hexachlorobenzene		<MDL		0.88	1.78 ug/Kg		<MDL	G	0.89	1.79 ug/Kg			<MDL	G	1.3	2.52 ug/Kg		<MDL	G	1.1	2.21 ug/Kg
Hexachlorobutadiene		<MDL	G	1	2.01 ug/Kg		<MDL	G	1	2.02 ug/Kg			<MDL	G	1.4	2.85 ug/Kg		<MDL	G	1.2	2.5 ug/Kg
Hexachloroethane		<MDL	G	20	40.2 ug/Kg		<MDL	G	20	40.5 ug/Kg			<MDL	G	28	56.9 ug/Kg		<MDL	G	25	49.3 ug/Kg

# King County Environmental Lab Analytical Report

PROJECT: 423056-16C

Norfolk CSO Sediment Remediation  
Five-Year Monitoring Program  
Year Two - April 2001 Sampling Event

Locator: NFK503  
Descrip: Boeing Storm Drain Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-5  
Matrix: SALTWTRSED  
% Solids: 74.7

Locator: NFK503  
Descrip: Boeing Storm Drain Channel  
Sampled: Apr 24, 2001  
Lab ID: L20703-6  
Matrix: SALTWTRSED  
% Solids: 74.1

Locator: NFK504  
Descrip: Upriver Reference  
Sampled: Apr 24, 2001  
Lab ID: L20703-7  
Matrix: SALTWTRSED  
% Solids: 52.7

Locator: NFK504  
Descrip: Upriver Reference  
Sampled: Apr 24, 2001  
Lab ID: L20703-8  
Matrix: SALTWTRSED  
% Solids: 60.1

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
<b>COMBINED LABS</b>															
Indeno(1,2,3-Cd)Pyrene	<MDL	12	24.1	ug/Kg		<MDL,G	12	24.3	ug/Kg		<MDL,G	17	34.2	ug/Kg	
Isophorone	<MDL	25	30.9	ug/Kg		<MDL,G	26	51.3	ug/Kg		<MDL,G	36	72.1	ug/Kg	
Naphthalene	<MDL,G	19	37.5	ug/Kg		<MDL,G	19	37.8	ug/Kg		<MDL,G	27	53.1	ug/Kg	
Nitrobenzene	<MDL	21	42.8	ug/Kg		<MDL,G	22	43.2	ug/Kg		<MDL,G	30	60.7	ug/Kg	
N-Nitrosodimethylamine	<MDL,G	27	33.5	ug/Kg		<MDL,G	27	54	ug/Kg		<MDL,G	38	75.9	ug/Kg	
N-Nitrosod-N-Propylamine	<MDL	12	24.1	ug/Kg		<MDL,G	12	24.3	ug/Kg		<MDL,G	17	34.2	ug/Kg	
N-Nitrosodphenylamine	<MDL	27	33.5	ug/Kg		<MDL,G	27	54	ug/Kg		<MDL,G	38	75.9	ug/Kg	
Pentachlorophenol	<MDL,G	6.7	13.4	ug/Kg		<MDL,G	6.7	13.5	ug/Kg		<MDL,G	9.5	19	ug/Kg	
Phenanthrene	8.4	<RDLE	5.4	10.7	ug/Kg	<MDL,G,E	5.4	10.8	ug/Kg		15.6	G,E	7.6	15.2	ug/Kg
Phenol	<MDL,G	12	24.1	ug/Kg		<MDL,G	12	24.3	ug/Kg		<MDL,G	17	34.2	ug/Kg	
Pyrene	5.9	<RDLE	5.4	10.7	ug/Kg	<MDL,G,E	5.4	10.8	ug/Kg		<MDL,G,E	7.6	15.2	ug/Kg	
* Not converted to dry weight basis for this parameter															